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O. P. BRYSCH, Editor

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1. MANAGEMENT

Methane Liquefaction

Liquefied Natural Gas and the International Energy Market. J. D. Balcomb. Spec. Study No. 1, Inter. Energy Reports. (New York: Worldmark Economic Publications, Inc., 1958, Dec.)

Coincidental with the first boat shipment of liquefied gas to London, this report reviews earlier technical and economic studies and recent reports of the Working Party on Gas Problems of the Economic Commission for Europe, with special attention to U. S. activities. Historical development and technology of liquefaction and storage are outlined. Economic studies of Burns and Clark, Crecca, Lederman and William, the ECE and Gaz de France in terms of minimum delivered costs (cents/MCF) are compared for shipments from the Middle East to London, $.50.5; Venezuela to London, $.30-$.64; Venezuela to New York, $.25; Sahara to Marseilles, $.43 and Venezuela to Philadelphia, $.32. Breakdown of costs in relation to wellhead price, processing, shipping and storage is presented. Relation of fixed and variable costs, depreciation, operating scale and price trends are mentioned. The Gulf Coast, Western Canada, Caribbean, Sahara and the East Indies are discussed as sources of supply, with figures on reserves and current and potential annual production. Europe, Japan and the U. S. are discussed as potential markets, with fuel demands and current prices. Appendices of construction requirements, conversion factors, patents and bibliography are included. (See also *Gas Abstracts 15*, 2, 10.)

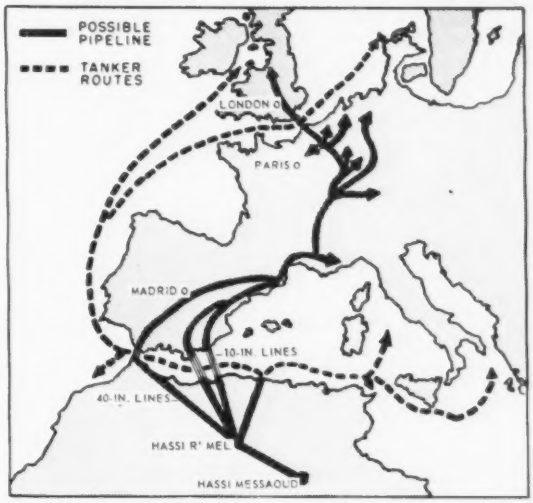
Liquid Methane May Stage U. S. Boom. *Oil Gas J. 57*, 51 (1959) Feb. 2 (2 pp.)

Result of successful voyages by the Methane Pioneer will be to open vast new markets in Western Europe and Asia for gas now going to waste in South America, Africa and the Middle East. But even before that occurs, other outlets for liquid natural gas may be created nearer at home. New company has been formed in New York to develop facilities for all phases of gas liquefaction. It is owned jointly by J. F. Pritchard & Co., Kansas City, Continental Oil Co., and Union Stock Yard and Transit Co., Chicago. Latter two firms also are partners in Constock Liquid Methane Corp., which is promoting Methane Pioneer venture with the British Gas Council. Brief review of economic and energy features.

Gas Industry Expansion

Industry Hits $4.5 Billion Mark, Looks to Continued Growth in '59. J. T. Wolfe. *Gas Age 123*, 25 (1959) Jan. 8 (4 pp.); **Customers Total 32 Million in 1958.** *A.G.A. Monthly 41*, 3 (1959) Jan. (4 pp.); **Sales**

POSSIBLE WAYS OF MOVING GAS FROM ALGERIA TO ENGLAND AND EUROPE



(Adapted from *Western Europe May Burn Sahara Gas.* See abstract, p. 30)

Hit $4.5 Billion in '58. *Gas 35*, 64 (1959) Feb. (4 pp.)

Year-end pattern for 1958 showed: 1) record-breaking customer total of 32 million; 2) new high in utility and pipeline revenues of $4574 million, for a 10.6% gain; 3) sales up 3.1% to a record high of 79.8 billion therms; 4) pipeline and main mileage of 564,100 miles; 5) gross plant investment up 10.2% to $18.4 billion, and 6) gas reserves at better than 246 trillion CF, and ultimate estimated at better than 1000 trillion CF.

Gas Appliance Outlook for 1959. E. R. Martin. *Gas Age 123*, 29 (1959) Jan. 8 (4 pp.); **GAMA See Sales Up 9.1 Per Cent.** *A.G.A. Monthly 41*, 8 (1959) Jan. (8 pp.)

Anticipated 1959 industry unit sales vs. estimated 1958 unit sales in 11 categories are as follows (first figure in each category is for 1959; second for 1958): domestic gas ranges, 1,883,100 vs. 1,837,600; automatic gas water heaters, 2,742,100 vs. 2,621,700; gas central heating equipment, 1,134,700 vs. 1,090,000; gas direct heating equipment, 1,371,500 vs. 1,345,300; gas vented recessed wall heaters, 406,200 vs. 379,400; gas floor furnaces, 87,500 vs. 94,900; gas clothes dryers, 461,600 vs. 412,100; gas incinerators, 65,300 vs. 47,900; gas unit heaters, 124,300 vs. 110,100; gas duct furnaces, 20,300 vs. 18,200; and commercial gas ranges, 34,300 vs. 31,000.

"Domestic Air Conditioning Market . . . Challenges Entire Industry." R. F. Horan. *Gas Heat and Comfort Cooling 10*, 26 (1959) Jan. (2 pp.)

Everybody—manufacturer and wholesaler as well as dealer—must do what he can to get "men on the hoof" to sell residential air conditioning. This is gist of article by specialist in sales and management training.

Gassers Drop for Second Straight Year. *Oil Gas J. 57,* 136 (1959) Jan. 26 (2 pp.)

New records were established in 1958 by the natural-gas industry. This is notable in view of the fact that gas completions continued to fall for the second straight year. Marketed production of natural gas was up 3%, natural gas reserves increased 2.3%, natural gas liquids reserves rose 8.3%. Total number of gas completions dropped 238 wells, off 6.1% over the previous year's total.

LPG Is a Jolly Good Fellow, Old Chap. W. S. Amos. *Butane-Propane News 21,* 36 (1959) Feb. (4 pp.)

Over-all consumption of LPG in Britain more than doubled in the six years from 1950-56. In 1950, sales stood at around 30,000 tons (14.7 million gal). In 1956, (latest figure available) total was 70,000 tons (34.3 million gal). Domestic users of LPG account for 85% of all sales. Although still in its infancy, the LPG industry is undergoing rapid growth in the British isles.

Gas Industry Management

Natural Gas Supply and Price Trend. *Gas Age 123,* 32 (1959) Jan. 8 (4 pp.)

Latest FPC figures on pipeline purchases reveal 7000 producers in supply picture, but 30 account for 2/3 of wellhead sales. Wellhead prices continue uptrend, averaged $.12/MCF in 1957. Article includes table showing direct sales by producers of natural gas to natural gas pipeline companies—1957. Producers mentioned are those whose combined sales were 2 million MCF or more.

Machine Processing of Production Data . . . An Integrated Approach to Management Problems. N. J. Ream. *Chem. Eng. Progress 55,* 51 (1959) Jan. (4 pp.)

It is typical to define responsibilities of management as the guidance, leadership and control of a group of individuals toward some common objective. This indicates management's purpose but fails to provide an insight as to how results are obtained. Better definition would include following five basic processes: Planning, organizing, assembling resources, directing and controlling.

The Analogy Between the Problems of Systems Engineering and Management. H. H. Goode. *Chem. Eng. Progress 55,* 48 (1959) Jan. (3 pp.)

Principles used for design of large-scale systems are reviewed, with emphasis on differences between large-scale equipment system and large-scale management systems, and translation of some of the system design principles into a form applicable to management. Resulting principles must be bent, stretched and molded into a shape which will make them directly applicable to new problems. Therefore, no attempt can be made to reformulate principles set forth in article in precisely the form in which they would apply to management problems. This step must be taken by the manager himself.

Management of the Future. E. D. Reeves. *Chem. Eng. Progress 55,* 45 (1959) Jan. (3 pp.)

Manager's job does not consist of doing kinds of things that machines can do, but rather of planning, organizing, coordinating and guiding. Tools he uses to do his job consist of machines, men and ideas. Technology will not simplify his task, but instead will make life more difficult. Future managers will be faced with essentially the same problems they have always had to deal with, but job will be more complex, challenge far greater, and need for those who can meet the challenge, more urgent.

Foreign Activities

Western Europe May Burn Sahara Gas. *Oil Gas J. 57,* 114 (1959) Jan. 26 (3 pp.)

Two ideas are being pushed by former French minister, Maurice LeMaire. One is an African-to-Europe pipeline that runs under the Mediterranean. The other calls for moving the gas by tanker as liquid methane. Study commission says gas can be laid down in Europe at $.51/MCF by tanker and even less by pipeline. But some big "ifs" cloud future of both proposals.

£18 Million in Major Gas Expansion Work. *Nat. Gas Bull. 22,* 19 (1958) Dec. (2 pp.)

Striking figures which emphasize vast extent of development work in progress in the Australian gas industry today are listed in latest issue of "Major Development Projects, Australia." Excerpts from that publication are presented. Only major works exceeding £100,000 are listed. Yet total of these for the gas industry is £18 million—£15 million completed in the past two years. Sixteen projects were completed by June 1958, and nine are under construction.

Developments at the Grangetown Works of the Wales Gas Board. J. B. Currier. *Gas J. 297,* 60 (1959) Jan. 14 (5 pp.)

Inclusion of new or unusual plant to the Grangetown works has added to the interest of reconstruction work. In particular is the Gastechnik installation which is the first full-scale plant erected in Great Britain; the Humphreys & Glasgow liquid purification plant; the butane/propane peak load installation, and the 1½ MMCF/hr jet booster. Annual

output has increased from 2458 MMCF in 1944-45 to 4423 MMCF in 1953-54. Similarly the maximum daily output has risen from 8.7 MCF in 1944-45 to 16.9 MMCF in 1953-54.

How the Use of Town Gas Helps Industrial Productivity. H. R. Hems. *Ind. Gas 22,* (Brit.) 6 (1959) Jan. (3 pp.)

Among the combustible fuels, availability of gas at any point and its flexibility and controllability are unique. Latest figures indicate that in the highly industrialized areas of Britain, more than 50% of the total gas output is now used in factories and other industrial establishments and that the percentage is still increasing. Author enlarges on the reasons for this growing demand and outlines a few of the developments in industrial gas equipment design which are helping industry to meet its increasing production demands in an economic and efficient manner.

Legal

Patent Suit Has LPG Industry Edgy. *Oil Gas J. 57,* 58 (1959) Feb. 2 (2 pp.)

Pan American and Skelly are initial targets in Sid Richardson's effort to collect on his salt-cavern patent. Involved is the basic process of leaching out storage by dissolving salt with water. Royalty asked: ⅛-cent/gal.

Pipeline Construction

Gas Lines Lead Construction Upturn. *Oil Gas J. 57,* 162 (1959) Jan. 26 (2 pp.)

Natural gas lines will make a strong comeback in 1959, but their increase will be offset in part by an expected decline in crude oil and products construction. Outlook for 1959, based on a worldwide survey of companies, shows: U. S. natural gas—12,500 miles compared with 10,000 miles in 1958; U. S. crude—2000 miles compared with 3100 in 1958; U. S. products—1000 miles compared with 3100 in 1958; Canadian natural gas—800 miles compared with 2300; Canadian crude oil—450 miles compared with 550; Foreign—5500 miles compared with 5300.

Texas-Florida Gas Line Pushes Ahead. *Oil Gas J. 57,* 100 (1959) Jan. 26 (2 pp.)

Gas system that many thought would never be built will start moving gas into Florida about June 1. Skeptics are watching the unfolding of a $163,757,300 success story. This is the initial capital investment by Houston Texas Gas & Oil Corp. and Coastal Transmission Corp., subsidiaries of Houston Corp. Project includes 2,654 miles of trunk lines and laterals between McAllen, Tex., near the Mexican border, and Miami. Coastal is building the line from McAllen to Baton Rouge. Houston Texas, is taking the line from Baton Rouge. Some 700 miles of pipe have been put in the ground during 3 months of construction. Completion is scheduled by May 1. On June 1, the 24-in. main line should be ready to move a daily average of 282,000,000 CF, with maximum capacity of 287,000,000 CF. Original system will have eight compressor stations totaling 40,500 hp.

Petroleum

The UK—A Heavy-Oil Economy. C. W. Wood. *World Petrol. 30,* 35 (1959) Jan. (4 pp.)

At the 11-month mark (1958), UK oil industry picture was one of great activity in preparation for higher demand. In no field has progress been more significant than in petrochemicals. Trading has been keenly competitive because of a world oil surplus at a time of a minor industrial recession, but trading results are likely to be better than anticipated at one time. Welcome sign in recession recovery is the lessening in trade gap over the first 10 months to £345.5 million from £580.5 million in the same period of 1957. Even more encouraging factors are October's record trade with the U. S. and fact that British goods have kept up all through American recession. Further, sales to Canada have resumed their upward trend. Many such factors could be quoted which must influence production and thus, ultimately, oil demand.

The Emergence of Order Out of Chaos. *World Oil 148,* 135 (1959) Jan. (13 pp.)

General discussion of the impact of the discovery of oil on the course of civilization includes summaries of growth in oil demand, development of natural gas, era of production waste and chaos, conservation measures, effects of imports, financial requirements of the industry, oil's contribution to the U. S. tax bill, survey of competitive picture and perusual of how technological advancements have enhanced supply.

Imports Rose to All-Time High in '58. *Oil Gas J. 57,* 150 (1959) Jan. 26 (2 pp.)

Theoretically, 1958 was the year when imports were to be brought under control, but actually 1958 saw total imports of petroleum and its products increase by 79,000 bbl/day, or 5%, to the all-time high of 1,654,000 bbl/day. There were some controls put on crude oil imports and they had a significant effect. Crude imports dropped by 76,000 bbl/day, or 7.4%—averaging 947,000 bbl/day in 1958 compared with 1,023,000 bbl/day in 1957.

For 1959—Products Demand to Climb 4.7 Percent. S. W. Downer III. *Petrol. Eng. 31,* C-3 (1959) Jan. (5 pp.)

Domestic demand for all petroleum products will reach 9,440,000 bbl/d in 1959, a 4.9% increase of

1958 demand. Although 1958 was a record year, estimated demand of 8,996,000 bbl/d was only 2.3% above 1957 . . . relatively poor growth compared to past performance. Export requirements for products refined in U. S. will increase only slightly, up to 267,000 bbl/d, as compared to 264,000 bbl/d in 1958. Exports showed a marked decline in 1958, down from an average of 425,000 bbl/d in 1957 . . . during the first months of which the Suez crisis was still in full swing. Total demand in 1959 for domestic and export markets will be 9,707,000 bbl/d, 4.7% above the total of 9,260,000 bbl/d estimated for 1958. Almost no growth was made in total demand in 1958 compared to 1957. Decline in export needs held growth to a slim 0.4%.

Petroleum Development

Petroleum Panorama. *Oil Gas J. 57,* (1959) Jan. 28.

Special issue to commemorate oil's first one hundred years is divided into six sections which discuss advances or review phases of industry. These sections are: Profile of an Industry; Exploration; Drilling; Production; Transportation and Refining-Petrochemicals.

The First Oil Well. P. A. Dickey. *J. Petrol. Tech. 11,* 14 (1959) Jan. (13 pp.)

Article reviews economic conditions, technology, demand for oil, etc., during the period just preceding and immediately following the birth of the oil industry on August 27, 1859. Story of Edwin L. Drake is included.

Cost Accounting

The Economic Liability to Replace. A. A. Ring. *Public Util. Fortnightly 63,* 73 (1959) Jan. 15 (10 pp.)

Liability to replace method measures accrued depreciation as an economic fact whether provision is made for depreciation or not. Physical or technological impairment of an asset, as measured by the equal percentage or straight-line method, is converted into loss of value by ascertaining present worth of the dollar liability that must be met at time of replacement. System is shown in practice to be virtually as accurate as lengthy engineering or "observed" study methods of experts.

Drilling

New Developments in Drilling and Producing. *Petrol. Eng. 31,* B-19 (1959) Jan. (5 pp.)

Most drilling equipment developments point to faster rates in an attempt to trim costly rig time. Air and gas drilling certainly will find wider acceptance as a result of advanced techniques and water shutoff methods evolved in 1958. Research is continuing on a fast-drilling, fast-moving hydraulic rig. Revolutionary new methods—turbodrilling, vibratory and percussion drilling—are all being tested. Slim-hole drilling can be expected to gain from the industry's drive to cut tubular good expense in the form of small diameter casing, casingless and tubingless completions.

Journal Forecast: 52,746 Wells in '59. *Oil Gas J. 57,* 120 (1959) Jan. 26 (2 pp.)

Drilling will be up in 1959 after two sharp reductions. Total completions dropped 4322 wells in 1957 and lost another 4727 wells in 1958. Reports from operators in every active state indicated planned increases for 1959 in the range of 3500-4000 wells. Journal's forecast, based on these reports, includes 10,820 wildcats and 41,926 development wells. Projected total completions of 52,746 wells represent a gain of 7.4%.

Completions Drop Below 50,000. *Oil Gas J. 57,* 122 (1959) Jan. 26 (2 pp.)

Completions in the U. S. last year fell below the 50,000 mark for the first time since 1953. Total well completions were 49,111 in 1958, compared with 53,838 wells in 1957. This was a net drop of 4727 wells, or 8.8%. Gas-condensate wells have shown a steady gain since 1956, the first year in which separate figures have been compiled. This classification jumped from 688 in 1957 to 1125 wells in 1958. Oil-well completions dropped 3339 during 1958, gas wells were off 238 during the same period; there were 1879 fewer dusters during 1958, while service wells (those drilled as water supply, or for water flood) were up 292 in 1958.

Wildcats Continued to Slide in '58. *Oil Gas J. 57,* 124 (1959) Jan. 26 (6 pp.)

Exploratory drilling in 1958 continued its decline, a trend started in 1957. Oil hunters in the nation's oil provinces dug only 9588 wildcats compared to 11,739 the previous year. Year's tally shows 920 new oil finds, 158 condensate discoveries, 273 gas strikes and 8237 dry wildcats completed. This score compares with 1172 new oil pools in 1957, 105 condensate strikes, 375 gas finds and 10,087 dry exploratory attempts. Total wildcat footage drilled in 1958 fell to 44,576,670 ft compared to 55,794,214 ft the previous year.

Exploration

Oil Finding Costs Hit New Peak. H. J. Struth. *Petrol. Eng. 31,* B-24 (1959) Jan. (7 pp.)

Hazards attending the search for new oil reserves are emphasized to an alarming degree by the continued upward spiral of oil finding costs. In 1957, the initial cost of finding a barrel of oil in the U. S.

averaged $1.33, while finding cost in previously unexplored areas was $2.36/bbl. These figures represent only about one-third of the ultimate cost of finding, developing and producing oil, which now is priced at $3.10.

Information

Problems of Mechanizing Storage and Retrieval of Information. M. Taube. *Chem. Eng. Progress 55*, 60 (1959) Jan. (4 pp.)

Rapid survey of data information systems pointing to the manner in which each one attempts to decrease the cost of storage and to increase the speed of retrieval by the development of codes, by the dense packing of codes in a storage medium, by the physical arrangement of the storage media, and by various methods of prefiling or organizing the information.

Information Systems. E. Wall. *Chem. Eng. Progress 55*, 55 (1959) Jan. (5 pp.)

Increasingly complex technology, growing specialization make problems of "keeping up-to-date" more difficult—and more vital. Important examination of techniques of storing information and of locating it for immediate use.

Safety

Land Shipping Radioactive Material. D. E. Patterson and R. V. Batie. *Nat. Fire Protect. Assoc. Quarterly 52*, 202 (1959) Jan. (7 pp.)

Radioactive materials are, by definition, substances which give off energy in all directions in the form of particles or rays. If sufficient of these emanations reach living persons or animals, they may cause various kinds of injury. Particles or rays can also damage physical materials which must be kept free from radiation, for example, photographic film. Article outlines some problems experienced by members of the Atomic Energy Commission's National Reactor Testing Station in Idaho in connection with assuring safety of radioactive material.

Toxicity and Fire Potentialities of Common Chemicals in Industry. B. F. Postman. Part 1. *Air Conditioning, Heating and Ventilating 55*, 65 (1958) Dec. (4 pp.); Part 2. *Ibid. 56*, 88 (1959) Jan. (4 pp.)

Article is directed toward industrial plant which is too small to employ a safety engineer or an industrial hygiene engineer but which, nevertheless, requires guidance to promote health and safety of plant personnel and to prevent fires as the result of the chemicals or processes used. Emphasis is placed on common industrial chemicals and normal manufacturing processes.

2. ENERGY SUPPLY AND ECONOMICS

Gas Reserves

Louisiana: Key to Future U. S. Gas Supply? *Gas Age 123*, 36 (1959) Jan. 8 (5 pp.)

Sharply increasing scale of Louisiana's increments to gas reserves makes this area most significant one in the entire country. Southern Louisiana fields are already setting the pace in pricing for the industry as a whole. True, Texas with 113,085 billion CF of proved natural gas reserves at the end of 1957 still outranks all other states in this respect by a wide margin. But Louisiana has been rapidly overtaking its neighbor in recent years. With an area less than a fifth of that of Texas, its proved natural gas reserves had risen, by the end of 1957, to 51,436 billion CF, or 45.5% of those of Texas. Surging growth of Louisiana's gas reserves appears to have been centered in the relatively new discoveries of gas fields in the state's southern parishes, i.e., of Vernon, Rapides, Avoyelles and all parishes to the south. This inference is derived from an analysis of recent gas purchases in Louisiana by interstate pipelines.

Canadian Gas Position and Prospect. *Gas Age 123*, 29 (1959) Jan. 22 (6 pp.)

Royal Commission on Energy finds "that with any reasonable assumption regarding the growth of reserves in Alberta and British Columbia there will be a moderately increasing volume of gas in excess of Canadian requirements available for export." Article presents excerpts from the first report (popularly known as the Borden Report) of the Commission. These excerpts relate to "permission to export natural gas" and "considerations affecting the granting of export licenses."

Petroleum

World Crude Production Tops 18 Million Barrels Daily. *World Petrol. 30*, 32 (1959) Jan. (3 pp.)

Estimates indicate that world production of crude oil increased 2.4% in 1958 to 18,098,900 bbl/d. These are based on operations during the first 10-11 months. Increase of 424,000 bbl/d was smallest in volume as well as percentage in recent years. Increase compares with 1.1 million bbl/d in 1957, 1.2 million in 1956 and 1.6 million in 1955.

Petroleum Reserves

Liquid Reserves 39.71 Billion Barrels. *Oil Gas J. 57*, 138 (1959) Jan. 26 (3 pp.)

Gross addition to reserves of crude oil and natural gas liquids amounted to 3302 million barrels; of this 2471 million was crude and 831 million natural gas liquids. Deducting total production of 2740 million barrels, the net gain stands at 562 million barrels for

1958. Further breakdown reveals that 88½ million of this was crude and 473½ million natural gas liquids. Louisiana retained its lead as the chief contributor of new gas reserves, as well as new oil. Other large gas suppliers were Texas, Kansas, Oklahoma and Wyoming. Oklahoma, New Mexico and North Dakota accounted for substantial oil gains.

Energy Sources

The Century Ahead. *Am. Gas J. 186,* 17 (1959) Jan. (10 pp.)

Gas industry's future position depends, to a large measure on competition . . . competition in the form of price and in the form of nuclear techniques, electricity and other fuels. So say leading industry authorities whose opinions and predictions were compiled into this special report. Their speculations are based, in part, on projections of various factors that will influence the future. From these, it is possible to determine probable trends, especially those related to population. This includes per capita use of energy, which coupled with population growth, allows an estimation of future energy demands. Dr. Martin Elliott and Marvin Chandler estimate that the cumulative energy demand in the U. S. for the period 1958-2000 is 3.6Q. (The unit Q is 10^{18} Btu, or 10 trillion therms of natural gas.) This is small compared to total fossil fuel reserves of 41.9Q but it must be remembered that complete recovery of the total reserves will never be achieved. Contrasted to the latter figure, it is estimated that U. S. reserves of nuclear fuel are about 1500Q, nearly 400 times the energy requirements of the next 40 years. Science of nuclear energy utilization is still in its infancy, but it is one that will grow rapidly.

World Energy and World Oil. N. B. Guyol. *Petrol. Refiner 38,* 192 (1959) Jan. (5 pp.)

Economist reviews factors which give oil its position in the energy picture today and then looks ahead to the world's total energy requirements during the next 25 years and gives his views on how these requirements will be met. The other energy sources which play a part in the 1984 energy picture are discussed briefly by specialists in separate articles.

World Energy and World Oil: High Energy Fuels. W. R. Millard. *Petrol. Refiner 38,* 202 (1959) Jan.

Value of hydrocarbon fuels is probably best appreciated by chemist involved in synthesizing new fuels. Of all the elements, only hydrogen, beryllium and boron release more energy per unit weight on combustion than carbon. There is also a possibility that lithium, magnesium and aluminum can be used to synthesize fuels more energetic than hydrocarbons. These, however, are specialty fuels and will not invade any of the present energy markets. In fact, this industry may become strongly dependent on petroleum and petrochemicals.

World Energy and World Oil: Coal and Lignite. W. C. Schroeder. *Petrol. Refiner 38,* 200 (1959) Jan. (2 pp.)

Including lignite and peat, there is a tremendous reserve of almost 150Q of coal (about 26 trillion barrels of oil). If costs are right, this fuel will make heavy inroads into both the fuel and chemical industries.

World Energy and World Oil: Gilsonite. E. F. Goodner. *Petrol. Refiner 38,* 201 (1959) Jan.

Although the present refining capacity will be increased to 1000 tons/day feed rate, big use may be in chemical production rather than for fuel purposes.

World Energy and World Oil: Nuclear Energy. A. J. O'Donnell. *Petrol. Refiner 38,* 196 (1959) Jan. (2 pp.)

Ship propulsion and process heat show promise for adoption of this form of energy which will account for about 10% of the world energy supply during the next 25 years.

World Energy and World Oil: Shale Oil. F. L. Hartley. *Petrol. Refiner 38,* 197 (1959) Jan. (3 pp.)

Declining cost of shale recovery along with increasing costs of oil exploration and production will change shale vs. crude picture. Trillion-barrel shale reserve will be used moderately.

World Energy and World Oil: Solar Energy. G. O. G. Lof. *Petrol. Refiner 38,* 201 (1959) Jan.

An oil well on a quarter section of land would have to yield 2500 barrels daily perpetually to equal the solar energy received on that piece of ground. Universal availability and great abundance of solar energy makes this a tempting supply for the future.

World Energy and World Oil: Tar Sands. G. W. Hodgson. *Petrol. Refiner 38,* 199 (1959) Jan. (2 pp.)

Although very rapid advances are predicted, only a relatively small percentage of the tremendous potential of tar sands will be tapped as a sourceof energy by 1984.

World Energy and World Oil: Miscellaneous Energy. J. J. McKetta. *Petrol. Refiner 38,* 202 (1959) Jan. (2 pp.)

At least a dozen other forms of energy are available, and although they will increase threefold by 1984, they will still account for only 1.5% of the total energy used. These sources will consist of water power, wood, wind, wave energy, fuel cells, free radicals and others. Dark horse to watch is the fuel cell.

The Impact of Chemical Industry on Electric-Gas Utilities. C. E. Wright. Part 1. *Public Util. Fortnightly 63,* 16 (1959) Jan. 1 (7 pp.); Part 2. *Ibid.,* 83 (1959) Jan. 15 (8 pp.); Part 3. *Ibid.,* 165 (1959) Jan. 29 (6 pp.)

In Part 1, the author discussed chemical complex of Texas, petrochemical boom in Louisiana and chemical progress in Arkansas and Oklahoma. In the next installment he discusses industrial expansion in the South Atlantic states in which the chemical industry, hand in hand with the ample provisions of power supplied by the electric and gas utilities, has been instrumental. Part 3 covers progress of the "test tube" companies, along with electric and gas utilities, during the last few years in some northern, midwestern and western states.

Where Are the Fuels for Tomorrow's Heating Needs Going to Come From? G. W. Rusler. *Heating, Piping & Air Conditioning 31,* 146 (1959) Jan. (4 pp.)

U. S. is using up its coal, petroleum and natural gas resources so fast that a fuel crisis is indicated within the next 20-40 years. Petroleum location and production are growing more difficult as these reserves are depleted. Main factor contributing to probable future petroleum shortage will be the large exponential expansion indicated by present demand. Oil from oil shales is not the answer, so other sources must be developed for heating beyond the next 40 years.

Fuel Cells

Fuel Cell: Competitor or Consumer? *Oil Gas J. 57,* 72 (1959) Feb. 9 (2 pp.)

It will be some time before fuel cell is ready to assume either role. But laboratory work is under way at several spots, and long-range potential is both promising and intriguing. For the moment, though, there are a lot of problems on road to success. Companies working on solutions are National Carbon, Consolidation Coal Co., Chrysler Corp., Lockheed Aircraft Corp., Esso Research and Engineering Corp., General Electric Co., Allis-Chalmers Manufacturing Co., General Motors Corp., Patterson-Moos division of Universal Winding Corp. and others.

Competition

What's Ahead for Fuel Oil. *Nat. Petrol. News 51,* 149 (1959) Feb. (8 pp.)

Survey studies housing outlook, gas heat and electric heat's plans and burner research to determine expansion plans of oil's toughest competitors and an analysis of oil heat's needs. Outlook for housing indicates that a million single-family units may go up in 1959, and this could well be the annual housing volume for the next five years. Gas counts on adding about 1.3-million home accounts annually until 1970. That would give it 33.7-million residential accounts. Electricity sees 3 million all-electric homes by 1965, two years ahead of earlier estimate. Oil heat's biggest need is research.

Solar Energy

Kinetic Complications Associated with Photochemical Storage of Energy. R. M. Noyes. *J. Phys. Chem. 63,* 19 (1959) Jan. (4 pp.)

If energy is to be stored in a photochemical process, initial act of absorption of a photon must be followed rapidly by additional reactions. These can be classified according to whether or not a non-absorbing species must react either with the excited absorber or with a fragment formed from its dissociation. Because of the compressed time scale in which many of these additional reactions must occur, the kinetic treatment requires consideration of the special problems associated with very fast reactions.

The Photolysis of Nitrosyl Chloride and the Storage of Solar Energy. O. S. Neuwirth. *J. Phys. Chem. 63,* 17 (1959) Jan. (3 pp.)

Nitrosyl chloride, dissolved in carbon tetrachloride, is photochemically decomposed by light below 6400 A into nitric oxide and chloride. Quantum yield is reduced by reverse reaction and values of 0.75 or less up to approximately 1.0 are obtained. Experiments using sunlight with a flowing system are described. Nitric oxide is insoluble and can be stored and later recombined with chlorine in carbon tetrachloride to give the original nitrosyl chloride and release some of the solar energy consumed in the photolysis.

Method and Apparatus for Generating Electrical Power from Solar Energy. H. A. Toulmin, Jr. (assigned to Basic Research Corp.) U. S. 2,864,789 (1958) Dec. 16.

In a solar generator, a plurality of thermoelectric elements arrange to form a hollow cylinder having an inner wall, means comprising a lens system to concentrate heat rays of the sun into a beam within said cylinder proximate to but spaced from the inner wall thereof to energize said elements by radiation from said beam and means at the bottom of said hollow cylinder to reflect the beam of heat rays against the inner wall of said cylinder to further energize said thermoelectric elements.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Automation

Production Automation. D. R. Patterson. *Petrol. Eng. 31,* B-31 (1959) Jan. (7 pp.)

Seven areas of automatic controls for the oil and gas industry are defined, categorized and justified before article develops the why, where, when and how much of automation in oil and gas producing applications. Areas of automation include: automatic well control, automatic well testing, automatic tank switching, lease automatic custody transfer, automatic lease process control, automation supervisory control and office machine automation.

Drilling

'Desert Star' Is Libya Bound. *Petrol. Eng. 31,* B-56 (1959) Jan. (2 pp.)

"The Desert Star," highly mobile and unitized rig has been added to Camdrill International's foreign drilling fleet. New 9000-ft capacity rig, specially designed, constructed and fitted for desert operations, will drill for Esso Standard. All major components of the rig are mounted on five 12 ft-wide semi-trailers; one drawworks and one mast trailer, two heavy-duty pump trailers and one utility trailer.

Drilling Practices. *World Oil 148,* 159 (1959) Jan. (22 pp.)

Great strides in drilling methods and equipment have been realized during the first 100 years of oil. Numerous major advances in hole-making techniques, machinery and tools have made possible the attainment of ever-increasing depths at constantly faster speeds, as well as the overcoming of such obstacles as high pressures, sloughing intervals and exceedingly hard zones that previously caused hole abandonment. Most progress has occurred since mid-1920, a period which marked the real entrance of steel and engineering into the oil industry. By providing the means of reaching oil at greater depths and under conditions previously impossible, these developments have been a major factor in the industry's ability to discover and produce enough oil to meet rapidly growing consumption and, at the same time, build up a huge volume of proved, unproduced reserves for future use.

Laboratory Study of Effect of Overburden, Formation and Mud Column Pressures on Drilling Rate of Permeable Formations. R. A. Cunningham and J. G. Eenink. *J. Petrol. Tech. 11,* (AIME Petrol. Trans., T.P. 8048) 9 (1959) Jan. (9 pp.)

One phase has been completed of a laboratory investigation of formations with relatively high permeability under conditions of overburden, formation and mud column pressures. It was found that: Drilling rate decreased when mud column pressure was greater than formation pressure; adequate jet velocities helped clean filter cake and chips away and resulted in increased drilling rate; drilling rate increased slightly when formation pressure was greater than mud column pressure; overburden pressure had practically no effect on drilling rate.

Louisiana Onshore Drilling Costs. L. R. Records. *Oil Gas J. 57,* 102 (1959) Feb. 2 (4 pp.)

Data for about 300 wells are presented graphically to show average drilling costs for onshore wells in South Louisiana. Money spent on mud is a major drilling cost. Mud conservation equipment appears to be a must. Figures do not include 1958 costs.

Turbodrill: A Specialized Tool—Not a Cure-All. W. B. Bleakley. *Oil Gas J. 57,* 86 (1959) Feb. 2 (2 pp.)

Industry panel agrees that the turbodrill with diamond bits can be used economically where rotary rock bits make less than 75 ft before failure; rotary penetration rate is less than 10 ft/hr; rig cost is greater than $50/hr; hole diameter is less than 9 in.; formations are medium-hard to hard; trip time is long (deep hole), and rig hydraulics are adequate to handle the turbo tool. Turbodrill with rock bits has application where penetration rates are low; hole size is large; formations are hard but not abrasive; trip time is short and rig hydraulics are adequate.

Exploration

Oil Discovery Techniques. *World Oil 148,* 148 (1959) Jan. (11 pp.)

Article stresses importance of contributions made by geological knowledge to the technical progress and subsequent improvement in the industry's discovery rate. At least 80%, and probably 85%, of tests drilled in unproven locations in the U. S. are based on geological information. On the average, approximately 13% of this number is likely to find oil or gas production. Of the remaining 15-20%—drilled without geological advice—only 3% probably will be productive. An even higher percent of the wildcats drilled outside the U. S. is based on geological studies, and because of working in more virgin territory with modern techniques, an even higher percent is successful.

Geology

Paleozoic Oil Prospects Look Good in Eastern Nevada. E. G. Johnson. *Oil Gas J. 57,* 148 (1959) Feb. 9 (5 pp.)

Much better understanding of geology of eastern Nevada is beginning to emerge as a result of the

combined efforts of oil companies, state and federal geological surveys, university groups and individuals in the last decade. However, much more field work is needed in areas where the stratigraphic section is exposed, primarily to help in understanding the geology of the Paleozoic column in the intervening areas where valley fill and Tertiary lake beds mask the geology of the underlying deposits.

Salt Domes: Favorite Home for Oil. *Oil Gas J. 57,* 138 (1959) Feb. 2 (5 pp.)

Along the Gulf of Mexico's coast, oil and gas are drawn from reservoirs abutting 278 known domes or salt structures, on and off shore. Quite simply, the Gulf Coast has much of its oil because it has salt domes. It has, in fact, probably a greater number of intensely-studied domes than in any other area. Article answers questions on why last statement is true, how salt domes trap oil and gas; whether they still grow and whether the domes in themselves are usable.

Logging

What's New in Mud-Logging Techniques. J. G. Caran and S. H. Caran. *Oil Gas J. 57,* 116 (1959) Feb. 9 (5 pp.)

Drilling of more and deeper exploratory wells has developed a need for better ways to measure and identify hydrocarbon gases in the mud stream and drill cuttings. One of the new methods is called "spectrometric." Spectrometric gas analysis was successfully employed on the second-deepest well in the world, Shell Oil Co.'s 5 Rumberger in Elk City field, Beckham County, Oklahoma.

Reservoir Engineering

Calculating Recovery by Cycling a Retrograde Condensate Reservoir. W. C. Sheldon. *J. Petrol. Tech. 11,* 29 (1959) Jan. (6 pp.)

Theory and principles covering cycling a retrograde condensate reservoir have been discussed by other investigators. Methods for calculating recovery data also have been presented. However, calculating rate of dry gas invasion or dilution when cycling a thick reservoir presents some problems. Vertical sweeping depends upon the permeability range or distribution of permeabilities in reservoirs where thickness of the productive zone approaches the distances between wells. Article discusses the concept of permeability variation, or V factor, and presents curves to relate sweeping efficiency with pore volumes of dry gas injected for various permeability variations. From these considerations a "dilution factor" has been developed for various permeability variations.

Determining Recoverable Gas Reserves. D. H. McLendon. *World Oil 148,* 215 (1959) Jan. (3 pp.)

Recoverable gas reserves can be determined, with a reasonable degree of accuracy, by certain calculations. They involve reservoir volume and conditions, producing conditions and physical characteristics of the gas. Nomograph presented is for calculation of the recoverable gas reserves from a volumetric or expansion-type reservoir. To arrive at one continuous expression involving only multiplication and division operations, it was necessary to resort to algebraic substitutions. Classic formula does not lend itself to use in a nomograph.

Mammoth Water Injection Program Ready. E. Lundburg. *Calif. Oil World 52,* 1 (1959) Jan. (2 pp.); **Subsidence Area Rises.** *Oil Gas J. 57,* 112 (1959) Jan. 26.

Bulwarked by an opinion from the state attorney general, Long Beach, Calif., is progressing with its proposed $30,000,000 capital improvement program for water injection facilities in the port sector of the Wilmington Oil Field. To effect, a five-year program is planned which would involve ultimate injection of 1,717,000,000 bbl of brine, all of which would be produced from city-operated wells. This brine would be furnished private operators of Fault Blocks II and III under terms of a unit operation which currently is being formulated voluntarily by interested parties, including the city, the Union Pacific Railroad, the Southern California Edison Company and General Petroleum Corporation.

Predicting Reservoir Performance. H. H. Power. *Petrol. Eng. 31,* B-79 (1959) Jan. (9 pp.)

Previously, the prediction of reservoir performance by use of the material balance and other mathematical means has been effected by the use of the relative permeability concept. It has been found that experimental values of relative permeability, as determined in the laboratory, do not reflect the original and subsequent fluid distributions in actual reservoirs nor the mobility experienced in the reservoirs under usual production practices. It is probable that nonuniform saturation-permeability relationships exist from one portion of a reservoir to another and the relative permeability for the unit is therefore a weighted average value representing all the instantaneous variations in permeability along flow lines into the well bore due to differences in effective permeability, saturation, withdrawals, segregation, migration, pressure and pressure gradients.

Secondary Recovery

Calculation of Relative Permeability from Displacement Experiments. E. F. Johnson, D. P. Bossler and V. O. Naumann. *J. Petrol. Tech. 11,* (Tech. Note 2027) 61 (1959) Jan. (3 pp.)

Method is presented for calculating individual gas

and oil or water and oil relative permeabilities from data obtained during a gas drive or a waterflood experiment performed on a linear porous body. Method has been tested and found both rapid and reliable for normal-sized core samples.

Factors Influencing the Efficiency of Miscible Displacement. R. J. Blackwell, J. R. Rayne and W. M. Terry. *J. Petrol. Tech. 11,* (AIME Petrol. Trans., T.P. 8047) 1 (1959) Jan. (8 pp.)

Article discusses results of an experimental investigation of factors that control efficiency with which oil is displaced from porous media by a miscible fluid. Study was conducted to elucidate relevant processes both on microscopic level (within individual or between neighboring pore spaces) and on macroscopic level (within a large sand body).

Oil Recovery by Thermal Methods. T. W. Nelson and J. S. McNeil, Jr. *Producers Monthly 23,* 14 (1959) Jan. (12 pp.); *Oil Gas J. 57,* 86 (1959) Jan. 19 (13 pp.)

Discussion of application of thermal methods has been organized under three principal headings: Oil well heating, hot fluid injection and in-situ combustion. Latter process consists basically of igniting the oil in a reservoir and moving this burning front slowly from one well to another by continuous injection of air. Examples of this basic process are "heat wave" process, halting combustion part way between the injection well and the production well, and use of a "reverse combustion" technique. Economics of in-situ combustion appear reasonably attractive under field conditions that exist in a number of areas in the U. S. today. Further development of the process promises to extend its application appreciably to the point at which it could become a significant factor in oil production in many areas.

Transfer of Fluid Components in a Porous Medium at Constant Saturation and Fluid Velocity. R. F. Nielsen and R. E. Gilchrist. *J. Petrol. Tech. 11,* (Tech. Note 2026) 57 (1959) Jan. (4 pp.)

When a gas is displaced by another in a porous medium, and there is a relative immobile liquid present, there is a transition zone in which the gas composition varies from essentially that of the original gas to that of the injected gas. Change in extent of this zone with time may be governed by a mixing process in the direction of flow and by the rate of establishment of gas-liquid equilibrium, if the gases are appreciably soluble in the liquid. Relative importance of these two factors in determining the growth of the transition zone is discussed, with appropriate equations and experimental data.

Well Practice

Completing High Pressure Gas Wells—Mechanics and Problems. R. A. Kilsdonk. *J. Petrol. Tech. 11,* 35 (1959) Jan. (3 pp.)

Discussion is limited to high pressure gas wells or wells with abnormal pressure gradients. It does not include extreme high pressure gas wells. Data on these are meager since relatively few have been completed to date. Wells discussed might be termed as medium high pressure gas wells having pressure gradients of about 0.8 psi/ft of depth. Experiences with three wells recently completed in the Gulf of Mexico approximately three miles off the Texas coast near Mustang Island are discussed.

Completion Methods. *World Oil 148,* 185 (1959) Jan. (6 pp.)

Early improvements include gradual replacement of lightweight, soft casing with low-carbon steel casing. Next step was to use heavier weight pipe with longer couplings. Seamless casing came into use during the 1920's. Drilling of deeper wells also has entailed many refinements in cementing techniques. More powerful surface pumping equipment, coupled with better downhole cementing equipment, and advances in the cement itself have met all the problems of cementing higher pressure and higher temperature wells. Prior to universal adoption of gun and shaped charge perforating techniques, attempts to make upper horizons available in a single casing string consisted of using acid-soluble and drillable pipe sections. Set opposite upper producing zones, they provide a means of easily and efficiently opening them up for production at later dates. This practice came into considerable use in the 1930's.

Foaming Agents Are Low-Cost Treatment for Tired Gassers. H. N. Dunning and J. L. Eakin. *Oil Gas J. 57,* 108 (1959) Feb. 2 (3 pp.)

Treating gas well with foaming agents frequently can remove brine accumulations from relatively deep wells; remove heavy oil from sand face, casing and tubing, and remove scale, clays, mud and solid particles from the well bore and pipe string.

Oil Well Perforating Efficiency Improved with New Liner Material. R. D. Cocanower. *Petrol. Eng. 31,* B-70 (1959) Jan. (2 pp.)

Interpretation of published data often has led to conclusion that copper alone is most desirable material for shaped charge liners to obtain peak performance. However, further study of liner materials has revealed the desirability of liners containing low-melting-point metals. When such liners are used, resulting perforations are completely free from slugs or "carrots" and thus provide greater drainage area in the oil-bearing formation. Liner material used was

selected from a group of metals which melt at a temperature lower than that produced by the compression resulting from the detonation of an explosive charge in contact with the liner. Many commercially available metals can satisfy this melting point requirement.

4. GAS CONDITIONING AND LPG RECOVERY

Condensate Removal

Field Separation of Liquids in Oil and Gas Production. 1. How the Various Processes Compare in Payout. F. E. Cooper. *Oil Gas J. 57,* 91 (1959) Feb. 9 (3 pp.)

Primary process aim is to extract the most liquid hydrocarbons out of the stream. Considerations controlling choice of method to be used are: Line pressure (low or high-pressure gas line); wellhead pressure; liquid content of the stream; sale of the fluid and whether dehydration is necessary.

Field Separation of Liquids in Oil and Gas Production. 2. Building a Closed-System Adsorption-Type Unit. B. W. Bourne. *Oil Gas J. 57,* 93 (1959) Feb. 9 (2 pp.)

There are two basic methods used for separation of various components that exist in the passing from the simple separator: 1) adsorption and 2) oil absorption. In adsorption, the material is taken from the gaseous phase and retained on the surface of an adsorbent. Most familiar adsorbents are charcoal, silica gel and activated alumina.

Field Separation of Liquids in Oil and Gas Production. 3. Low-Temperature Separators and Combination Units. A. W. Francis. *Oil Gas J. 57,* 94 (1959) Feb. 9 (2 pp.)

There is an application for low-temperature separators and hydrocarbon-recovery units used in combination. Hydrocarbon-recovery units tend to supplement low-temperature separation and do not supplant it. Combination of the two will give a better range of effective sizing. If low-temperature separation is used in the early and more productive phases of the field, one can build the hydrocarbon-recovery unit for a large volume, relatively speaking, of lean gas and let it process, at a later date, a smaller volume of a much richer gas.

Field Separation of Liquids in Oil and Gas Production. 4. Low-Temperature Processing Has Built-In Flexibility. J. R. Heumann. *Oil Gas J. 57,* 95 (1959) Feb. 9 (2 pp.)

Low temperature required in low-temperature separation depends upon choking to obtain the degree of refrigeration needed. If high pressure is not available, an external source of refrigeration is required. To fill this need, an absorption refrigeration unit was developed. It was designed around oil-field components and controls that will stand up to the rugged conditions found in the industry.

Hydrogen Sulfide Removal

Study of the Rate of Hydrogen Sulfide Absorption by Arsenic-Soda (Thylox) Solutions. M. I. Gerber et al. *Zhur. Prikladnoi Khimii 31,* 1624 (1958) No. 11 (4 pp. Russian text.)

Absorption of H_2S by solutions containing Na_2HAsS_3O, $Na_2HAsS_2O_2$ and Na_2HAsO_4 is studied as a function of H_2S partial pressure, pH and temperature of solution.

Assoc. Tech. Services, Inc.

Condensate Removal

Method and Apparatus for Separating Water and Fluid Hydrocarbons. R. W. Donnelly (assigned to The Texas Co.) U. S. 2,866,834 (1958) Dec. 30.

Continuous method for separating water and condensed hydrocarbons from high-pressure gas streams comprises first cooling gas stream by heat exchange (with tail gas) to form hydrocarbon hydrates, separating condensed liquids, further cooling gas by expansion, again separating liquids and recurrently interrupting the first cooling to flush out the hydrates by warmer incoming gas.

Hydrogen Sulfide Removal

Cyclic Adsorption Processes for Recovery of H_2S from Natural Gas Employing Two Activation Cycles. E. B. Miller (assigned to Jefferson Lake Sulphur Company). U. S. 2,861,651 (1958) Nov. 25.

Improved cyclic adsorption process recovers H_2S from natural gas at high pressures by passing raw gas through a series of cylindrical beds of silica gel adsorbent. These beds are mounted between rotating plate disc valves and rotate within a pressure vessel. Each bed in turn passes through a cycle of stages as adsorber, purge, first activation, purge, second activation, purge, so that H_2S is adsorbed, then removed from the bed by two activation stages, where preheated steam is continuously cycled.

Process for the Purification of Gases. W. Herbert, H. U. Kohrt, R. Becker and F. Danulat (assigned to Metallgesellschaft, AG.) U. S. 2,863,527 (1958) Dec. 9.

Process is claimed in which a non-polar solvent (methanol) is used as a single scrubbing liquid (Rectisol) at temperatures of $-10°$ to $-75°C$ and pressures of 2 to 200 atm for removal of hydrogen sulfide, organic sulfur, gum and resin formers, cyanogen compounds and carbon dioxide from fuel gas

in one or more scrubbing stages. Water may be added to scrubbing to form a eutectic of low freezing point. Liquid is regenerated by release of pressure in a separate (or multiplicity of) vessel which, by evaporation of impurities, also cools the liquid to low operating temperature. Butane-propane also may be removed from natural or refinery gas by adding a proportion of C_6-C_{12} gasoline to the scrubbing liquid. Sidestream of depressurized liquid is rectified and returned continuously to remove high-boiling impurities.

Removal of Sulfur from Gas Streams. A. G. W. Lamont (assigned to Houdry Process Corp.) U. S. 2,866,679 (1958) Dec. 30.

High-pressure streams of gaseous and liquid hydrocarbons are freed of hydrogen sulfide and ammonia by a two-stage process which comprises contacting the cooled hydrocarbon stream with aqueous ammonium hydroxide in a first vessel to form contaminated ammonium hydroxide and hydrocarbons, and then withdrawing gaseous hydrocarbons and scrubbing with sodium hydroxide in a second vessel to form a purified gas and contaminated NaOH. Contaminated ammonium hydroxide is regenerated by boiling out the H_2S in a third vessel. Liquid hydrocarbons from the first vessel are desulfurized by contacting with the contaminated sodium hydroxide which then goes to waste.

5. NATURAL GAS TRANSMISSION

Compressibility

Calculating Supercompressibility. F. M. Partridge, E. E. Brough and F. W. Cagle, Jr. *A.G.A. Monthly 41,* 28 (1959) Jan. (5 pp.)

Calculation of least squares approximations for PV is outlined and the supercompressibility factors are compared with A.G.A. and Olds, Reamer, Sage and Lacey data.

Compressors

Pulsation Dampening on Reciprocating Compressor Installations. R. E. Mayne. *Pipe Line News 31,* Insert 9 (1959) Jan. (5 pp.)

New approach to pulsation problem has been realized through combined efforts of the Southwest Research Institute and the Southern Gas Assn. Pulsation research project has resulted in development of an Electro-Acoustical Analog which simulates compressor plant operations electronically. It, in itself, represents a major step in the technical advance of the industry. Article presents a semi-technical discussion of gas pulsation causes and effects and outlines a new approach toward a solution of this problem. Some practical applications also are reviewed.

Compressor Stations

Water Supply for the Pacific Northwest Pipeline Systems. J. T. Carter, Jr. *Gas 35,* 103 (1959) Feb. (5 pp.)

Major consideration in design of compressor station facilities was keeping water requirements to a minimum. Design features which were adopted to minimize water difficulties consisted of utilizing enclosed water systems with air cooled radiator equipment on those systems requiring cooling facilities. Station itself requires only small amounts of water for make-up in the engine jacket water and oil cooling water system. Since a glycol anti-freeze is used, provisions have been made to drain each engine jacket into storage to avoid loss when the jacket system must be drained for overhaul or repairs.

Engines

Evolution in Gas Engine Turbocharging. W. R. Crooks. *Gas 35,* 108 (1959) Feb. (4 pp.)

During the last decade, output of a typical 14-in. bore by 14-in. stroke 2-cycle gas engine has been increased by at least 100%. This power increase had been attained with only a 37% increase in fuel consumption. In other words, for little more than one-third additional fuel, today's user of gas engines is able to produce twice the power he did a decade ago and without increasing space requirements. And no longer is it necessary to derate engines for altitudes as in past years.

Metering

Saturable-Core Oscillator Integrates Gas-Flow Data. L. M. Langley. *Electronics 32,* 42 (1959) Jan. 23 (2 pp.)

Measurement of gas quantity for custody transfer and billing purposes often requires integration with respect to time of an electrical signal representative of flow rate. Such integrations may be performed by a variety of electrical or mechanical methods. Article discusses saturable-reactor-oscillator integrator which operates on principle that time-base integration of a variable may be performed by counting the cycles of an oscillator whose frequency is proportional to the variable.

Pipeline Construction

Construction of Long-Distance Pipelines for Gas and Oil. H. Geilenkeuser. *Gas- u. Wasserfach 100,* 1 (1959) Jan. 2 (7 pp. German text.)

Author discusses some of the problems and their solutions encountered in long-distance pipelines. Planning is outlined for materials handling. Problems

of joints and coupling and standard tolerances of pipe sizes and applications of welding are outlined. Wall thickness and construction details of sump traps, valves and elbows, also special supports in regions of mine subsidence are mentioned. Comparisons of German and U. S. practice are noted.

Engineering a 26-in. Crossing on Carquinez Straits Bridge. W. E. Ross. *Gas 35*, 53 (1959) Feb. (6 pp.)

By agreement with the State of California, Pacific Gas & Electric Co. planned to build a new 26-in. main across the straits on the new toll bridge across Carquinez Straits (San Francisco area). Sizing of this main was established on two primary considerations, to take care of anticipated load growth and to replace capacity of two existing 12-in. mains on the old bridge. These two 12-in. mains will be abandoned in place when the state undertakes reconstruction of the deck of the old bridge. All pipe was manufactured under API-5LX grade X42 specifications, with a wall thickness of .406-in. and a weight of 111 lb ft. More than 3800 ft of pipe have been installed. Range of normal expansion and contraction for this length of pipe is in the order of ± 4 in. for average gas operating temperatures; maximum is ± 12 in. Pipe is anchored in the middle of the span and one-half of the total expansion is taken at each end of the bridge.

Pipe Failures: Causes and Effects—and Prevention by Proof-Testing. *Oil Gas J. 57*, 116 (1959) Feb. 2 (3 pp.)

Recent laboratory investigations have disclosed fatigue-type defects can be produced in ordinary cyclic stressing and also in resonance. In addition to observing fatigue-type failure in line pipe these have occurred during rail transportation of structural members. It is not practical to eliminate all defects in pipelines, and therefore it becomes necessary to consider only harmful defects in manufactured pipe and construction of the pipeline. Importance of proper inspection is recognized. Most important factor is proof testing. To eliminate long failures, water should be used. Air could be used to eliminate explosive mixtures, but it has not been established that use of air would eliminate a long failure in proof testing. It has been proved, however, that water testing will do so.

Rugged Terrain Makes Pemex Line Difficult. M. S. Albans. *Pipe Line Ind. 10*, 47 (1959) Jan. (2 pp.)

Swamps, rains, mountains and rocky terrains provide construction obstacles on 500-mile, 24-in. gas line from Pemex, Tabasco, to Mexico City, that Pemex must overcome to complete the line by 1960. Nearly 65 miles of line through southern lowlands is being constructed without any right-of-way clearing. Line is designed to carry 220 MMCF of gas/d without need of a compressor station. Initial flow to be delivered to Mexico City sometime in 1960 will be 175 MMCF/d; 45 MMCF/d will be supplied to industrial plants along the line. Some months after completion of the system, plans call for installation of two 7000-hp compressor stations, one in Orizaba and the other closer to Mexico City. These stations will increase daily capacity to 300 MMCF. As more gas is available, more compressor stations will be constructed.

Skin Diver and Pipeline 'Know-How' Team to Repair Underwater Break. M. J. Olive. *Pipe Line News 31*, 28 (1959) Jan. (3 pp.)

Arkansas Pipeline Corp. has two eight-inch lines crossing Red River just north of Shreveport, La. These lines, laid in 1931, tie the oil gathering systems of South Arkansas and North Louisiana to its main line to East Texas. Crude passing through these lines eventually goes to the Cities Service Refinery in Lake Charles, La. When a leak developed on the north line of the river crossing last fall, a skin diver was utilized to explore the river bottom throughout the leak area to determine if the pipe was exposed at any point and to see, or rather feel, what was lodged over the pipe especially in the leak area.

Technical Advances in High Strength Pipe. W. A. Saylor and A. B. Wilder. *Pipe Line Ind. 10*, 26 (1959) Jan. (5 pp.)

Pipe users and manufacturers began, through the API and the American Standards Association, to develop improved standard specifications and design codes. As a result, Section 8 of American Standard Code for Pressure Piping (ASA B31.1) was revised and adopted. General desire among pipeline designers and users brought about inclusion of a ladle carbon equivalent of .65 maximum in Section 8. API also revised Specification Std. 5L and API Std. 5LX. Prior to 1945, majority of line pipe in sizes 20- to 26-in. OD was manufactured either by seamless or by flash welding processes. In 1946 double submerged arc welded expanded line pipe was first produced and with it a greater flexibility was achieved in producing larger diameter pipe. Studies of steel making and pipe manufacturing practices, field construction methods including stringing, welding, ditching, covering and line pipe operating practices, have resulted in better pipelines.

25,530 Miles to Be Laid in 1959. M. A. Judah. *Pipe Line Ind. 10*, 24 (1959) Jan. (2 pp.)

Favorable regulatory actions prompts 172 U. S. pipeline operators surveyed to state they are planning construction of 16,631 miles of line and 731,667 horsepower additions to their systems in 1959. Rec-

ord year of pipeline construction was 1954, when 17,745 miles of line was laid in U. S. Station construction will continue at a high level in 1959; horsepower additions forecast will be up slightly over a near record 721,370 horsepower built in 1958. Foreign station work will show an increase in 1959 from 129,964 up to an estimated 133,500 horsepower.

What's Going On in Canadian Pipelining. T. S. Johnston. *Oil Gas J. 57,* 84 (1959) Jan. 19 (2 pp.)

Today Canada has 5100 miles of crude oil and products trunk lines and 6500 miles of gas trunk lines. Future speculative plans include 1) a crude line to bring western Canadian crude to Halifax, N. S. (line would be over 3000 miles long); 2) crude line from the West to supply the Montreal market which would be built at a cost of more than $300 million; 3) line which would transport butanes, pentanes and propanes to the Great Lakes area from western Canada, and 4) crude line from western Canada to Chicago, although economic attraction for such a line is not too evident.

Pipeline Systems

When Do You Build a Gas-Transmission System? L. W. A. Campbell. *Oil Gas J. 57,* 81 (1959) Jan. 19 (3 pp.)

Summary and brief discussion of various factors which go into design, construction and operation of a gas pipeline. Activities and responsibilities of producer, contractor and pipeline company are clearly indicated.

Piping

New Pipe Forming Process. *Pipe Line News 31,* Insert 6 (1959) Jan. (3 pp.)

Cal-Metal Pipe Corp.'s new pipe mill in Baton Rouge, La., incorporates new process in the progressive roll forming of welded pipe, "Natural Function Forming." With this method, rolling process starts by breaking down steel strip from the center out, with successive forming roll stands, holding the edge to skelp in a neutral position. It is claimed that this type of relaxed forming eliminates excessive cold working of the steel edges. Feature provides additional safety factor of uniform yield strength all around the pipe and permits an extreme latitude of pipe wall thicknesses.

Welding

Non-Manual Pipeline Welding. W. B. Handwerk. *Petrol. Eng. 31,* D-40 (1959) Jan. (2 pp.)

Four methods have possibilities for use on the right-of-way: 1) Submerged arc welding, 2) flash welding, 3) induction pressure welding, and 4) consumable electrode welding. First method is being used successfully in present-day double jointing equipment. Flash welding is being used by some pipe manufacturers in producing their longitudinal seam weld. Induction pressure welding, which is unaffected by wind or temperature, has been developed to the point of field use by Consolidated Edison Company of New York City.

Resistance Welding of Pipelines. B. E. Paton, C. V. Gorbunov, V. K. Lebedev, N. G. Ostapenko and M. D. Litvinchuk. *Petrol. Eng. 31,* D-47 (1959) Jan. (4 pp.)

Institute of Electric Welding and the All-Union Scientific-Research Institute for Oil Industry Construction (Russian) together with construction organizations, have continually carried on work aimed at finding new, more effective methods of welding pipelines. Principal shortcoming in Russia's widely applied method based on use of submerged arc welding lies in the far-from-complete mechanization of welding and line-up. Advantage of using automatic welding was great when short length pipe (6 meters or 19.5 ft) was being supplied, but in view of increase of pipe lengths to 12 meters and more, advantage of using automatic submerged arc welding is reduced because of the fewer pipe joints that go into a section.

6. GAS AND LPG STORAGE

Storage

The National Tube Division. M. Duffy. *Gas World 148,* 1204 (1958) Dec. 27 (2 pp.)

Brief history and description of contributions to pipelines made by the National Tube Division of the U. S. Steel Corp. Included in its operation is design and manufacture of pressure vessels in accordance with the ASME, Interstate Commerce Commission and government specifications. These include vessels for aboveground use in stationary storage or transporting corrosive or noncorrosive gases or liquids. Temperatures covered range from minus 320°F to 1000°F and pressures of from 500-10,000 psi. Facilities are available to provide seamless, welded or forged vessels, using stainless, alloy or carbon steels, the choice of which is dependent on design requirements and end use.

Underground Storage

New Station Expands East Ohio's Chippewa Storage Field. J. F. Ebdon. *Gas 35,* 116 (1959) Feb. (3 pp.)

Newest addition to underground gas storage operations of East Ohio is the Chippewa Station that was put into service in November (1958) for this heating season's operations. Though station is new, un-

derground storage of natural gas by the East Ohio Gas Co. is not a recent development. Company was among the first in the industry to take advantage of depleted oil and gas production fields to hold surplus natural gas from warm weather period underground until winter conditions accelerate demand.

Predicting Delivery Rates from Underground Storage Projects. R. G. Cook. *Gas 35,* 59 (1959) Feb. (5 pp.)

Delivery characteristics of a storage project are based on a multitude of variables, the exact manner and effect of their variation being largely unknown. These variables include reservoir pressure, back pressure held against the project's flow, effect of well spacing with its subsequent effect on drawdown pattern and reservoir sand conditions such as porosity, permeability, thickness and lateral extent. Each of the variables lends itself to quantitative analysis, given data with which to pursue a study of the effect of the variable on delivery from the project. The abundance of variables affords opportunity not only for determination of their effect on the problem under study, but also of becoming engrossed in investigations diverging from the main objective.

Storage

Container for Liquefied Gas. H. W. Altman and H. L. Johnston (assigned to H. L. Johnston, Inc.) U. S. 2,864,527 (1958) Dec. 16.

In a vacuum-jacketed storage vessel for liquefied gas materially below 273°K, an improved manhole-type entry is claimed comprising a permanently-fixed flexible (metal bellows) channel between the aligned openings in the inner and outer vessels. Openings are flanged to take bolted gasketed lids, with the inner lid being of smaller size to permit its manipulation in the flexible channel while retaining the vacuum in the jacket.

Underground Storage

Method and Apparatus for Removal of Liquefied Gas from Underground Caverns. W. C. Muller (assigned to National Petro-Chemical Corp.) U. S. 2,864,242 (1958) Dec. 16.

Method of withdrawing a liquefied gas (propane) from an underground storage cavern is claimed which comprises a surface receiver vessel connected by riser-conduit to the stored liquid and a vacuum pump to reduce pressure on receiver to cause vaporization and lifting action of vapor on the liquid column in the riser.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

The Production of Acetylene from Fuel Gases. J. G. King. *Coke and Gas 21,* 31 (1959) Jan. (2 pp.)

In Britain, where electric power is relatively expensive and there are no actually cheap sources of methane, the interest of the National Research Development Corporation was aroused by a proposal to utilize the greater part of the heat energy lost in the quenching of hot gases by using a gas turbine for this purpose and utilizing recovered energy. Combustion system suitable for methane and for operation with a gas turbine was designed; requirements of the turbine were taken on paper to the design stage. Starting on a scale of 200 CF/hr of methane and propane successful trials were conducted on a larger rig using 4000 CF/hr CH_4 with preheaters operating at 650°C. Advance to a larger scale was quite unsuitable for a college and the decision was taken to make use of the methane collected at the Mogden Purification Works of the Middlesex County Council.

Aromatics

Hydrorefining of Crude Benzoles for Pure Products. R. Middleton and D. Bradley. *Gas World 149,* 5 (1959) Jan. 3 (8 pp.)

Considerable experience of application of hydrorefining technique to British aromatics has been accumulated from the large-scale pilot plant at Thorncliffe. In study reported, advantage has been taken of the wide variety of light oils that are available in Great Britain. To illustrate latter point "typical benzoles" have been submitted for examination with sulfur contents as low as 0.4% and as high as 2.4% w/w. Article describes results of survey with particular emphasis on subsequent production of pure products.

Carbonization

Chemical Structure and Properties of Coal. XXI—The Kinetics of Coal Carbonization. D. Fitzgerald and D. W. vanKrevelen. *Fuel 38,* 17 (1959) Jan. (21 pp.)

Earlier studies of coal carbonization kinetics, in which the change in weight is used as a parameter for following the reaction, are considered and shown to give information concerned mainly with the evolution of tar, so that other methods are needed for the study of the kinetics of the evolution of the remainder of the volatile material. Method adopted is the determination of the flow rate of each of the gases, and frequent gas analysis. Vitrinites of a series of coals

varying in rank from anthracite to a high volatile coal and other macerals of one of these coals are examined. Experimental results for flow of hydrogen, methane, the other hydrocarbons, carbon monoxide and the rate of weight loss for some of the coals are shown.

Catalysts

Regeneration of Hydrogenating Catalysts with Hydrogen. S. P. Rogov et al. *Khim. Tekh. Top. Masel 3,* 29 (1958) No. 10 (5 pp. Russian text.) Laboratory study using coked silica-alumina catalysts is reported.

Assoc. Tech. Services, Inc.

Study of the Kinetics of Oxidation of Reduced Iron Catalysts and Ores with Steam for the Purpose of Obtaining Hydrogen. D. Y. Gamburg and B. L. Sarychev. *Khim. Tekh. Top Masel 3,* 16 (1958) No. 10 (3 pp. Russian text.)

Oxidation and reduction rates determined from changes in the solid phase, and volume and analysis of products.

Assoc. Tech. Services, Inc.

Coal

Infra-red Spectra of Solvent Extracts of Coals. J. K. Brown. *Fuel 38,* 55 (1959) Jan. (9 pp.)

Infra-red spectra of a number of extracts obtained with organic solvents from a weakly caking vitrain (82% carbon content), as well as the residues after extraction, have been examined in the range 700-4000 cm $^{-1}$. They show the principal characteristics of the coal spectrum and suggest that a major part of the vitrain consists of structures of basically similar chemical type. Spectra of materials obtained with comparatively poor solvents differ most from the coal spectrum. These contain hydrogen-rich structures that have both aliphatic (alicyclic) and aromatic components. Similarities between the spectra of extracts and the parent coals in the range of carbon content 78-89% are illustrated for two other vitrains and the implications they have in the study of solvent extracts in relation to coal structure are discussed.

Interpretation of the Intensities of X-Rays Scattered by Coals. S. Ergun and V. H. Tiensuu. *Fuel 38,* 64 (1959) Jan. (15 pp.)

X-ray studies of the structure of coals are reviewed, and various interpretations of the X-ray intensity bands of coals are discussed. Study covers all ranges of scattering angle and emphasis is placed on quantitative interpretation. Original data were obtained to aid in the interpretations and suggestions are made concerning promising lines of attack in future investigations.

Irradiation of Oxidation Products of a Bituminous Coal. C. R. Kinney and H. L. Lovell. *Fuel 38,* 38 (1959) Jan. (7 pp.)

Humic acid-like oxidation products have been prepared from a bituminous coal. Their loss of color on standing in dilute sodium hydroxide solution exposed to diffused light, and the change from water insolubility to water solubility, have been examined and a possible explanation suggested. Loss-of-color tests with oxygen excluded only are described, and the transformation was accelerated using irradiation.

Ethylene

Light Hydrocarbon Pyrolysis . . . The Effects of Pressure and Equilibrium Approach. H. C. Schutt. *Chem. Eng. Progress 55,* 68 (1959) Jan. (7 pp.)

Pyrolysis of the hydrocarbon feed stock is the primary process phase of an ethylene production unit, and its operation has a profound effect on the whole plant performance. High conversions and ethylene concentration in the pyrolysis products at sustained high yields from a given feed stock are generally the objectives of the cracking operations. They require a judicious postulation of the design premises as well as the rational application of chemical engineering theorems in the apparatus design.

Gasification

A Study of Steam-Carbon Complex. D. D. Singh, S. Parkash and B. R. Puri. *Chem. Ind. 18* (1959) Jan.

Coconut shell charcoal, freed of ash and degassed at 1200°C, was treated (10 g. portions) with superheated steam at different temperatures for four hours and then evacuated at 1200°C to determine the surface complexes formed. An appreciable amount of water is fixed at each temperature but there is no evidence, as reported by some workers, that it reacts with carbon during thermal treatment on degassing since hydrogen gas was not found at all among the gases evolved. It appears that all chemisorbed water is evolved as such.

Hydrogenation

Hydrogenation Products from Bituminous Coal and Sucrose at Elevated Temperatures; Spectral Comparisons. M. G. Pelipetz and R. A. Friedel. *Fuel 38,* 8 (1959) Jan. (7 pp.)

Nearly identical products were obtained by similar hydrogen treatments of bituminous coal and sucrose. Quantitative product distributions are compared. Infrared, ultraviolet and mass spectra show the chemical similiarity of the asphaltenes and oils obtained; differences are confined to variations in concentrations of the constituents. Analyses of the 450°C light oils from sucrose and coal show parallel

concentrations of naphthenes, paraffins, aromatics and phenols. Spectral comparisons provide further evidence of coal-like character of pyrolysis products of carbohydrates. Production of aromatics from sucrose supports find of benzenes in products from the thermal treatment of carbohydrates.

Oxygen

Oxygen: Demand to Rocket. *Chem. Eng. News 37,* 78 (1959) Jan. 19 (7 pp.)

Industry leaders predict a 33% increase in commercial oxygen production—an increase that should spiral oxygen output to a record 80 billion CF. Government's missile program probably will consume another 20 billion CF. Total use: at least 100 billion CF. This growth rate will topple previous record of 60 billion CF set in 1958. Lower purity oxygen sells for as low as $10-$15/ton. Prices for high purity run between $30-$50/ton in large volumes. When high purity is made electrolytically, it costs more than that made via the liquefaction process. (Latter route provides 99% of the nation's oxygen.)

Ore Reduction

Petroleum Techniques for Steel. F. D. Hoffert, E. A. Kelly and A. M. Squires. *Mech. Eng. 81,* 27 (1959) Jan. (4 pp.)

"H-Iron" Process is ready for commercial application, bringing petroleum refining techniques to the steel industry. Oil and natural gas will provide hydrogen for this new process which presents a challenge to the blast furnace. Process employs hydrogen as a reducing agent and incorporates standard petroleum refinery construction practice and processing economies. It is fully competitive with the blast furnace both in fuel efficiency and in unit capacity. More strictly, combination of H-Iron Process with electric steelmaking furnaces provides a challenge to the classical combination of blast furnace and open-hearth furnace as a route to ingot steel.

Refinery Gases

Refinery Gas Production. A. K. Davis. *Gas World 149,* 132 (1959) Jan. 10 (4 pp.)

Petroleum refineries operate on a feedstock which is generally given the name crude oil. In fact, there are hundreds of crude oils which vary considerably in their composition and properties. All of them are very complicated mixtures of hydrocarbons, ranging from the light cases (methane) right through to materials of molecular weights greater than 700. Most of the products separated or manufactured from crude oil are themselves also quite complicated mixtures of hydrocarbons and it is only in the cases of gases and low boiling factions that regular and complete composition analyses (in terms of individual chemical compounds) are undertaken. Within the refinery the term "petroleum gases" refers to those hydrocarbons which are normally vapor at atmospheric temperature and pressure. Article includes a list of these, together with their boiling points, molecular weights and heating values.

Reformed Gas

Some Methods of Reforming Refinery Gas. W. J. Cutler. Part 1. *Gas World 149,* 128 (1959) Jan. 10 (4 pp.); Part 2. **Endothermic Continuous Catalytic Cracking.** *Ibid.,* 176 (1959) Jan. 17 (4 pp.)

Reforming is defined as the modification of a hydrocarbon gas, or gaseous mixture containing hydrocarbons of high calorific value, so as to form a larger volume of gas possessing a lower calorific value. Some systems of reforming depend solely on the thermal decomposition of the hydrocarbon. As gaseous hydrocarbons with the exception of methane decompose readily at high temperatures. Next to methane, the most stable of hydrocarbon gases is ethylene, and this readily decomposes if heated to temperatures above 760°C. The decomposition of gaseous hydrocarbons can take place both in the vapor phase and in contact with hot surfaces, and since heat is usually absorbed during such reactions, it might be expected that if sufficient time be allowed for the gas to remain in contact with surfaces heated to between 800°C and 870°C, the only hydrocarbon gas that will remain in any considerable amount will be methane.

Shale Oil

Studies in Shale Oil. Part IX. Further Data on Emulsions and Sludges. G. E. Mapstone. *J. Inst. Petrol. 45,* 16 (1959) Jan. (2 pp.)

Methods of handling shale oil must be modified according to local requirements. Deposition of heavy sludges from oils which are not perfectly dry appears to be a characteristic of crude shale oils. Paper records some experiences with sludges from South African crude shale oil and indicates some differences between these and other shale oil sludges. Sludge that accumulated in the crude oil storage tanks was stabilized by waxes, asphaltenes and dust. Heating sufficiently allowed the waxes to melt and the asphaltenes to coagulate and settle out with the dust, thus allowing the sludge to be resolved.

Ammonia

Process for the Production of Ammonia Synthesis Feed Gas. D. B. Eastman and R. W. Chapman (assigned to The Texas Co.) U. S. 2,865,864 (1958) Dec. 23.

In purifying hydrogen from a gasification process in which traces of methane contaminate the gas, a

process is claimed in which the gas stream is contacted with liquefied nitrogen for completely condensing impurities, with freeze-ups of solid methane in the heat exchangers avoided by adding argon, carbon monoxide or nitrogen as freeze depressants in amounts of 1 to 3 mol percent to the hydrogen-rich stream.

Ethylene

Process and Apparatus for Conversion of Hydrocarbons. J. W. Begley and R. R. Goins (assigned to Phillips Petrol. Co.) U. S. 2,866,836 (1958) Dec. 30.

Improved heat transfer and less carbon formation with better acetylene and ethylene yields are claimed for a regenerative cracking furnace which comprises a first, an intermediate and a second refractory checkerwork packing with venturi-shaped mixing chambers between. Process flow is reversed between alternate ends of furnace, comprising steam preheating in first regenerative packing, mixing with hydrocarbon in first mix-chamber, cracking in intermediate checkerwork, passing into second checkerwork for quenching, and product withdrawal. On reversed flow, air is substituted for steam to heat the checkerworks.

Gasification

Gasification of Solid Carbonaceous Materials. D. B. Eastman and L. P. Gaucher (assigned to The Texas Co.) U. S. 2,864,677 (1958) Dec. 16.

Process for suspension gasification of coal to carbon and hydrogen is claimed with the improvement of forming first a slurry of coal particles in a vaporizable liquid (water, oils), heating this in tubular heating zone to vaporize the liquid under pressure, and passing the vapor suspension of coal to a reactor at a velocity of 25 ft/sec to react with a feed of oxygen-bearing gas.

Hydrogen

Process of Hydrogen Recovery and Recycle. E. L. D'Ouville and J. W. Mohlman (assigned to Standard Oil Company.) U. S. 2,864,761 (1958) Dec. 16.

Improved recovery of hydrogen for recycling in a petroleum reforming process is achieved by scrubbing the hot reformer effluent gases with molten sodium or other alkal-metal, whereby the hydrogen is absorbed as metal hydride and the other product gases pass to recovery system. Hot liquid hydride is immediately pumped to a decomposing reactor in which hydrogen is recovered without loss in temperature or pressure for the reformer reagent, and sodium is returned to the scrubber. Prior to sodium scrubbing, the sulfur, oxygen and other impurities may be removed from off-gases by scrubbing with molten A1Mg or with a first-stage Na section.

Hydrogen Sulfide

Process for Making Sulfur Free Hydrogen Sulfide. A. H. Maude and D. E. MacFadyen (assigned to Hooker Chemical Corporation.) U. S. 2,863,275 (1958) Dec. 9.

Sulfur-free hydrogen sulfide gas is made from hydrogen and sulfur by holding latter mixture rising from molten sulfur bath at 326°C and 10% excess hydrogen and passing it into a MoS_3 catalyst bed held at 330°C to complete the H_2S-forming reaction in vapor phase.

Ore Reduction

Apparatus for and Method of Reducing Ore. L. L. Newman. U. S. 2,833,643 (1958) May 6; *Iron Steel Eng. 35,* 22 (1958) Oct.

Improved yields in iron production are claimed in a reduction process which comprises arranging cyclone furnaces circumferentially around and discharging into the conventional blast furnace bosh. These furnaces are fired with pulverized slag-forming fuel and restricted oxygen supply to yield a major portion of heat and of reducing gases for the main furnace, and, concurrently, the blast furnace flue dust is fed into the cyclone furnaces for smelting. Cheaper non-coking coals can thus supply heat and reducing gas to aid the process; also the fuel cost for sintering the flue dust is saved.

Method of Treating Iron Oxide Fines. J. C. Agarwal (assigned to U. S. Steel Corp.) U. S. 2,864,686 (1958) Dec. 16.

Synthetic scrap iron product for use in steelmaking is produced by a two-stage fluidized bed, where iron ore is first reduced to FeO by H_2 and CO in a partially used gas from the secondary step, and then reduced to remove 75-90% of remaining oxygen in ore in secondary stage, with outgoing ore briquetted and agglomerated out of contact with oxygen.

Process for Reduction of Sponge Iron. O. Jensen (assigned to Norsk Hydro-Elektrisk Kval. K. S.) U. S. 2,865,732 (1958) Dec. 23.

Improved reduction of distintegrating-type iron ores is achieved in an electrical resistance shaft furnace by preheating the reducing gas (hydrogen or water gas) in a lower zone and reducing the ore plus recirculated sponge iron in a top zone. Shift-reacted top gas may be recirculated, and pressures up to 25 kg/cm^2 are used.

Two-Step Method of Removing Oxygen from Iron Oxide. T. F. Reed (assigned to U. S. Steel Corp.) U. S. 2,864,688 (1958) Dec. 16.

Improved direct gaseous reduction of iron ore is

claimed for a two-stage fluidized process, in which iron ore is fed downward through two reactors (superimposed or a partitioned shaft), fresh preheated hydrogen (with up to 25% CO) injected into lower secondary reactor, to reduce intermediate product to metal, the off-gases passing upward to reduce raw ore to FeO in an upper primary reactor, with control of temperature and gas composition in both beds at proper chemical equilibrium.

Synthesis Gas

Process or the Production of Synthesis Gas Without Catalysts. G. Greco (assigned to Montecatini, Soc. Gen. per l'Industria.) U. S. 2,863,749 (1958) Dec. 9.

In a partial combustion flame process for producing synthesis gases from liquid hydrocarbons, improved results are obtained by vaporizing the hydrocarbon, injecting vapor into the reactor through vanes to impart helical motion while injecting oxygen into the vapor in oppositely-directed motion from an annular chamber and maintaining the intimate mixture at 1000°C.

Production of Fuel Gases. E. Bartholome (assigned to Badische Anilin- & Soda-Fabrik AG.) U. S. 2,-863,748 (1958) Dec. 8.

Improved process is claimed for producing carbon monoxide and hydrogen from partial (flame) oxidation of fluid hydrocarbons. Process comprises adding finely divided catalyst of Group II elements and iron to the flame to suppress carbon formation and passing said hot gases with catalyst dust into a fixed bed, solid-fuel slagging gasifier for removal of catalyst and for formation of additional product gas.

8. GAS DISTRIBUTION

Compressors

Jet Boosting and Its Application in Wales. D. Craven and A. W. Spelman. *Gas J. 297,* 65 (1959) Jan. 14 (4 pp.)

Technique of jet boosting, although not new to the gas industry, has had only limited application. Increasing use of high pressures for transmission of gas has led to the development in Wales and elsewhere of jet boosting as a means of utilizing residual pressure energy at grid reception stations and other suitable positions. Article discusses theory and points out advantages and disadvantages of system.

Distribution Systems

'Master Planning' a Distribution System. T. H. Rennell, Jr. *Gas 35,* 68 (1959) Feb. (2 pp.)

New England Electric System's gas operations are carried on in 50 New England municipalities. Gas service is provided through 10 gas operating companies which range in size from 1200 to about 100,000 customers. Total of about 243,000 customers served by these companies live in areas which vary from rural to highly developed urban communities. Natural gas is used to supply all of the base load sendout and most of the heating load sendout except for the coldest days of winter when peak shaving is accomplished by manufacturing relatively small volumes of oil gas or propane air gas. Problems encountered by the 10 companies are typical of problems which beset other companies that have converted to natural gas within the last five or six years. Foremost among these is how to supply increasing customer demands for gas from existing distribution facilities.

A.G.L. Co. Is Pioneering New Type of Gas Stop. M. Lobl. *Nat. Gas Bull. 22,* 14 (1958) Dec. (2 pp.)

Progress has been made recently by the Australian Light Co. in developing more efficient equipment for temporarily stopping gas flow while mains are being repaired. Latest types of gas stops used by the A.G.L. are described, with advantages and disadvantages of each type enumerated.

Metering

Free Glass Block Meter Reading Window. *Gas Age 123,* 37 (1959) Feb. 5.

Customers of Northern Illinois Gas Co., are enjoying a modern convenience—glass block window, 12 in. by 12 in., which can be installed in basement, utility or garage with little expense and trouble in most homes and at no expense in the case of new home construction. Placed opposite meter, it saves reader valuable steps and customers necessity of waiting for meter readers.

Piping

Plastic in Distribution Piping. H. M. McDaniel. *Gas Age 123,* 25 (1959) Feb. 5 (3 pp.)

Review of plastic and its advantages and disadvantages in piping for gas transport, with special emphasis on plastic coated steel pipe. It became apparent to the A.G.A. in 1951 that it would be necessary to establish certain standards for use with plastic piping. Subcommittee composed of A.G.A. members and representatives of the plastic industry was set up for this purpose. It has issued a report which sets up minimum dimensions for various plastic materials. Most economical pressure carrying material today is steel. New product incorporates advantages, corrosion resistance of plastics and strength of steel.

Metering

Two-Chamber Gas Meter with Independent Measuring Chamber Means. H. Karal (assigned to Aronco Meter Products Corp.) U. S. 2,866,443 (1958) Dec. 30.

Slide valve mechanism permits alternate communication of a first and second meter chamber with the gas inlet and outlet of the meter. Motion of the flexible partition between chambers is transmitted by linkages and rocker arms to move the slide valve and also to drive the counter.

Mixed Gas

Control of Heating Value of Fuel Gas. J. H. Arnold. U. S. 2,865,724 (1958) Dec. 23.

Exhaust gas of low heating value is produced by burning a portion of natural gas with low air supply in an internal combustion engine. This exhaust gas is mixed with the bulk of natural gas supply to give a gas of intermediate heating value. Heating value is held constant by regulating the speed of the engine to yield more or less exhaust gas. Engine power is used to compress the air or the exhaust gas, or to aid in jet mixing of gases.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Gas Powered Air Conditioning. P. E. Chamberlin, C. W. Egbert, N. K. Hall, G. O. Kuhen, J. F. Moore and R. M. Wilson. *Air Conditioning, Heating and Ventilating 56,* 75 (1959) Jan. (13 pp.)

Air conditioning equipment, powered by gas, has been in successful operating in commercial and industrial buildings. Various refrigeration and dehumidification cycles are described with data on characteristics, application and economic considerations. Specifications are given for the various systems covered in comprehensive article.

Unique Control System Regulates Air Conditioning, Heating. J. F. Pink. *Heating, Piping & Air Conditioning 31,* 130 (1959) Jan. (4 pp.)

Principle of a new method for controlling heating, piping and air conditioning systems using transistor circuits is presented. System makes it possible to start several compressors in any desired sequence depending on the load. Safety controls for boilers and other equipment also are operated by this method. Features include low wattage requirements, easy expansion of existing facilities and a high degree of reliability. How a typical control system for an installation with five 500-ton air conditioning compressors and three 200-hp boilers operates also is discussed.

What Will Unit Ratings Mean? A. F. Ward. *Gas Heat and Comfort Cooling 10,* 21 (1959) Jan.

ARI Standard regarding capacity ratings applies to the following types of air conditioning equipment with cooling capacities of less than 135,000 Btu: 1) Air and water cooled packaged air conditioners with integral and remote condensers; 2) air and water cooled packaged air conditioners less built-in blowers with integral and remote condensers; 3) air and water cooled condensing units with matching remote cooling coils and blower units, and 4) air and water cooled year-round cooling and heating units.

Winning the Air Conditioning Odor Fight. Know Your Nose—Your Nose Knows. A. B. Hubbard. *Heating, Piping & Air Conditioning 31,* 138 (1959) Jan. (2 pp.)

Any discussion of odor problems would have to start with the nose since there is no other instrument as critical of an unpleasant aroma. The nose has a threshold above which odors can be detected, and it also can determine the threshold concentration. Article explains common concept of odors, how they can be detected and their relationship to psychology.

Air Pollution

Dealing with Noxious Gases. W. A. Damon. *Chem. Process Eng. 40,* 11 (1959) Jan. (2 pp.)

Treatment and disposal of noxious gases evolved in chemical processes is an important part of air pollution control. Article deals with gas cleaning and dust removal methods applicable to sulfur dioxide, hydrogen chloride, hydrogen sulfide, chlorine, oxides of nitrogen and fluorine.

New Approach to Wet Washing of Industrial Gases. C. A. Bainbridge. *Chem. Process Eng. 40,* 8 (1959) Jan. (4 pp.)

Article briefly discusses dust and fume recovery problems and then describes a new type of multiple-tube venturi scrubber of interest to the process industries.

Studies of Air Pollution Control by Southern California Edison Company. A. J. Haagen-Smit. *J. Eng. Power 81,* 1 (1959) Jan. (6 pp.)

Relative contribution of various pollutants found in the Los Angeles area is discussed. Processes designed to curtail emission of oxides of sulfur and nitrogen are described, as well as some results of experiments at the Southern California Edison Company's El Segundo Steam Station.

Burners

Analysis and Design of Injection-Type Burners for Industrial Furnaces. A. M. Levin. *Appl. Mech. Rev. 12,* 56 (1959) Jan. (From *Trudi in-ta Ispol' zovaniya Gaza Akad. Nauk SSSR,* 67 (1955) No. 3 (35 pp. Russian text.))

Hydraulic method is presented for calculating an ejector with a cylindrical mixing chamber and subsonic gas flow velocities. Results given of an experimental investigation of an injector-type gas burner agree well with the calculated values. To facilitate calculation according to the equations of ejection a nomogram has been drawn up for a burner working on a mixture of natural gas and air.

Yu. A. Lashkov
Courtesy of Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

An Investigation of Multi-Jet Gas Burners with Flame-Grid Attachment. M. A. Kondak and I. Y. Sigal. *Appl. Mech. Rev. 12,* 56 (1959) Jan. (From *Izv. Kievsk. Politekhn. in-ta 18,* 293 (1955) (17 pp. Russian text.))

Multi-jet gas burners with a flame grid attachment are intended for boiler and water heating installations. Combustion air is injected into the furnace by a stream of combustible gas issuing from the burner nozzles. To stabilize the flame, jets are shrouded in a wire-mesh attachment with 1.8-mm meshes, sufficiently narrow to prevent flashback of the flame. Tests of this burner showed that it works sufficiently steadily, without blowback or interruption of the flame, at gas pressures between 5 and 3000-mm water column. In the absence of separate cooling of the attachment it is best to work with a gas pressure of the order of 20-100-mm water column, and with a coefficient of primary air excess of the order of 0-0.85. A form of construction is described enabling the over-all dimensions of the burner to be reduced.

S. M. Il'yashenko
Courtesy of Referativnyi Zhurnal, USSR
Translation, courtesy Ministry of Supply, England

Combustion

Ignition of Combustible Gases. G. Rosen. *J. Chem. Phys. 30,* 298 (1959) Jan. (6 pp.)

Ignition of a combustible gas is studied by obtaining an approximate solution to the coupled equations of unsteady fluid flow, mass and heat diffusion, and chemical kinetics. At various stages, the theory is contrasted with the "excess enthalpy hypothesis." It is shown that the empirically established minimum ignition energy can be deduced from the well-established laws, without invoking the *ad hoc* "excess enthalpy hypothesis."

Kinetics of Methane Oxidation. I. The Dependence on Oxygen Concentration. E. M. MaGee. *J. Am. Chem. Soc. 81,* 278 (1959) Jan. 20 (4 pp.)

Experimental studies of the methane-oxygen reaction have been carried out in a quartz, flow-type reactor at 815° in order to determine the dependence of certain variables on the oxygen concentration. Results show that the maximum concentration of formaldehyde is proportional to the concentration of oxygen, a fact of great theoretical importance. Rate of disappearance of methane at the formaldehyde maximum is proportional to the concentration of oxygen raised to the 2.8 power and the concentration of oxygen at the formaldehyde maximum is 0.70 times the initial concentration. Time at which the maximum concentration of formaldehyde appears is a linear function of the reciprocal oxygen concentration. These results point out of the need for revision of previously proposed mechanisms for the slow oxidation of methane.

Flame Research

Automatic Stabilisation of Town Gas Flame in Furnace Control. K. A. Steel. *Fuel Efficiency 6,* 37 (1958) Dec. (4 pp.)

Wobbe index is becoming increasingly common as the controlling factor in gas supply after the statutory requirement has been met of delivering gas at the required calorific value. Importance of the index derives from fact that thermal output of a gas burner is a function of specific gravity as well as of calorific value. Value of a constant record of Wobbe index is therefore of great importance in furnace control.

A Novel Combustion Measurement Based on the Extinguishment of Diffusion Flames. A. E. Potter, Jr. and J. N. Butler. *ARS J. 29,* 54 (1959) Jan. (3 pp.)

It has been theoretically shown that when the flow of fuel and oxidant into a diffusion flame is too great, the chemical reaction cannot keep up, and the flame goes out. In an effort to use this effect as the basis of a measurement of general usefulness, a diffusion flame between two opposed gaseous jets, one of fuel and one of oxidant, was established. As the mass flows of fuel and oxidant were increased, a critical flow was reached at which the flame was extinguished in an area surrounding the jet axis. This phenomenon occurred abruptly at a reproducible flow rate. The maximum mass flow rate per unit area at which the flame is extinguished around the jet axis has been called the flame strength. Another investigator has used this same term to mean the maximum fuel (or oxidant) flow which a diffusion flame can support. Experimental flame strength discussed in article probably is not identical with the

quantity that the other investigator calls the flame strength in his theory, although the two are closely related.

The Recombination of Hydrogen Atoms and Hydroxyl Radicals in Hydrogen Flame Gases. E. M. Bulewicz and T. M. Sugden. *Trans. Faraday Soc. 54,* 1855 (1958) Dec. (6 pp.)

Recombination of free radicals H and OH in the burnt gases of hydrogen + oxygen + nitrogen burner flames at atmospheric pressure has been examined by flame photometric methods for temperatures in the range 1600-2400°K. Most important processes involved are considered to be $O + OH + H_2O \rightarrow H_2O + H_2O$, and $H + H + H_2O \rightarrow H_2 + H_2O$. Values of velocity constants are deduced, and at 1650°K are 1.5×10^{-30} cm^6 $molecule^{-2}$ sec^{-1} for the former reaction and 6×10^{-32} cm^6 $molecule^{-2}$ sec^{-1} for the latter. They decrease slowly with increasing temperature.

Research on Supersonic Combustion. R. A. Gross. *ARS J. 29,* 63 (1959) Jan. (2 pp.)

Detonation is a wave in which an exothermal chemical reaction takes place and which moves with supersonic velocity with respect to the undetonated (reactant) gas. It is characterized by this supersonic propagation velocity and a large pressure and temperature increase across the wave. A detonation differs from a flame (deflagration) in that a flame moves with subsonic velocity, and its microscopic propagation mechanisms are fundamentally different. Review of the status and recent developments in the field can be obtained from one of the references cited.

Furnaces

Fuel Savings up to 45%. J. W. Schulz. *Fueloil and Oil Heat 18,* 70 (1959) Jan. (3 pp.)

Large flue passages in any furnace or boiler invite application of heat rakes (baffles). Moving sluggishly through such large flue passages, hot products of combustion impart relatively little heat to indirect heating surfaces. Studies which consisted of reading temperatures at dozens of locations within such large flue passages show that while a burner is running such passages contain a small, hot core of gases traveling sluggishly through each passage, usually somewhat higher than the center, and in some cases moving only through the upper one-third part of the passage. Assembly can be made up by slipping baffle pieces on a suitable length of cold-rolled steel rod, and using pieces of pipe between the baffle pieces. Ends of the rod are threaded to take nuts, which along with large washers hold the assembly together rigidly.

Gas Heat Treatment Furnaces for Metals. L. Walter. *Gas World 149,* (Ind. and Comm. Gas Sect.) 11, (1959) Jan. 17 (3 pp.)

Design of heat treatment furnaces in general has been to make operation as simple as possible, but at the same time to achieve greater output. Use of improved materials, such as castable refractories, has helped to achieve increased capacity. Greater attention has been given toward maintenance of the best suitable furnace conditions, such as temperature, pressure and furnace atmosphere.

Heat Treating

Controlled Atmosphere Derived from Town Gas for the Heat Treatment of Metals. F. G. Ethelston. *Gas J. 297,* (Gas in Ind. Sec.) 10 (1959) Jan. 7 (4 pp.)

Techniques employing gaseous atmosphere for heat treating, sintering and brazing metals and alloys without damaging their surfaces by oxidizing, decarburizing, carburizing or discoloring during heating and cooling are well established and widely used, as are the techniques for surface hardening steel by gas carburizing and carbonitriding. Large proportion of atmospheres used in heat treating processes in England are derived from town gas and these generally are produced either by direct combustion with air in the furnace chamber, or by full or partial combustion in a separate gas generator. Atmospheres produced by both these methods are described and some of their limitations and advantages are considered. Seven accompanying tables indicate atmospheres employed for different heat treatment processes on commonly used metals and alloys.

Modified Martempering Permits Close Tolerance in Aircraft Pumps. E. C. Wallace and H. E. Crouse. *Ind. Gas 37,* (Amer.) 10 (1959) Jan. (3 pp.)

By conversion to heating in controlled atmosphere furnaces and quenching in martempering oil at temperatures from 260°-275°F, most of the difficulties encountered with former heat treating methods have been eliminated. Equipment consists of a martempering bath, two horizontal alloy muffles, controlled atmosphere furnaces, a gas generator, a signalling controller and a dew point recorder.

Industrial Heating

Factors Affecting the Use of Gas Fuel for Vacuum or Inert Gas Processing of Metals. D. H. Turner. (New York: A.G.A., 1958.)

Increasing interest in the application of vacuum and inert atmospheres to metallurgical processes motivated the gas industry to launch an investigation to determine what factors might affect the application of gas fuel to vacuum and/or inert atmosphere metallurgical processes and how this might affect the

future usage of gas fuel in the metals industry. Specific objectives of the study were to determine techniques which might allow the successful application of gas fuel to vacuum furnaces, limitations and problems of utilizing gas fuel, and to analyze metal trends that might affect the future utilization of gas fuel for metal processing.

Highway Asphalt Plants Offer Huge LPG Market. K. Kirkpatrick. *Butane-Propane News 21,* 29 (1959) Feb. (4 pp.)

When one company converted an asphalt plant from oil to LPG production increased 25%; product quality was improved; starting-up time decreased, and labor costs were reduced.

How Radiant Heating Has Speeded Annealing of Glass Containers. W. Clark, *Ind. Gas 37,* (Amer.) 2 (1959) Jan. (2 pp.)

Increase in production rate, elimination of breakage and other advantages were achieved by conversion to radiant heating in lehrs. Former heating method involved use of conventional low-pressure burners located under conveyor belts and a combustion chamber positioned approximately 6 ft from the entrance to blow hot air down on the containers as they entered. Use of a convection heating system with torch-type burners for quality glass annealing necessitated too long a heating zone. Installation of radiant roof panels just inside the lehr entrances answer most important need—replacement of heat to the tops of containers as they enter.

LPG for Plumbers—Only. W. Clark. *Butane-Propane News 21,* 33 (1959) Feb. (3 pp.)

Description of operation of Gas Arc Supply in Philadelphia which services the plumbing supply trade. In the late 1940's company's acetylene customers were still using gasoline in their metal melting pots. Leaded gasoline would tend to clog orifices and nonleaded gasoline was not always available. Pots had to be pumped up to make them fire. There was always danger from the gasoline can which was a necessary part of equipment. Review of company's experiences after conversion to LPG.

A Study of the Effect of Heating Rate by Gas on Metal Flow Characteristics or Plasticity and Die Wear. C. A. Turner, Jr. and A. A. Furczyk. Project I K-7, Part II (New York: A.G.A., 1958.)

Influence of heating rate by gas on flow characteristics or plasticity was investigated for types 1045 carbon, 4140 low alloy steel and 303 stainless steel. A single blow drop hammer with standard striking energy was used to upset standard specimens fast heated with no soak and slow heated with one hour soak to temperatures in the range 1800°F-2300°F. Per cent reduction in height was taken as a measure of metal plasticity. All three steels showed increase in per cent reduction in height by fast heating over that resulting by slow heating with one hour soak, over the full temperature range. This improvement in metal flow by fast heating confirms the findings of an earlier investigation for press forging field tests.

Refrigeration

Design and Performance of a Thermoelectric Refrigerator. J. B. Heinicke. *Refrigerating Eng. 67,* 34 (1959) Feb. (3 pp.)

Design of first thermoelectric refrigerator was based on design objectives which included: Small internal cooling space (2—2.5 cu ft capacity); quiet performance commensurate with good performance; utilization of best thermoelements; single-stage cooling, and utilization of materials pointing toward performance first.

Temperature-Controlled Chamber Using Thermoelectric Cooling. W. R. Danielson. *Refrigerating Eng. 67,* 30 (1959) Feb. (4 pp.)

Thermoelectric cooling, using the Peltier principle, has many potential uses in the refrigeration field. However, great improvements will have to be made in the materials before it can replace conventional refrigeration in most present day applications. A figure of merit of 8 to 10 $\times$ 10^{-3} K^{-1} is desirable for practical use. Today's materials offer only 2 to 2½ $\times$ 10^{-3} K^{-1}.

Smoke

The Estimation of the Darkness of Smoke by Visual Methods. L. E. Reed. *J. Inst. Fuel 32,* 3 (1959) Jan. (7 pp.)

Clean Air Act has laid down that method of assessing density of smoke issuing from chimneys shall be by comparison with the Ringelmann chart or by any other accepted method. Difficulties of method using Ringelmann chart are well known, and an optical instrument, the Telesmoke, has been devised to overcome some of them. Tests have been conducted under different atmospheric conditions in which density of smoke produced by an industrial boiler was assessed by three observers, one using a Ringelmann chart, one using the Telesmoke and one estimating the density of the smoke with the naked eye. Results have been compared with those obtained from a smoke meter of the photoelectric type.

Solar Energy

Economical Solar Heating Nears. *Air Conditioning, Heating and Ventilating 56,* 71 (1959) Jan. (2 pp.)

Moderate temperature heating, with maximum temperatures of approximately 200°F, seems to be first practical application of solar energy. While it holds

forth many possibilities in the commercial and industrial field—air drying, for example—its successful use in residential heating is very near because of research being conducted by various organizations. Application of "free" sun energy requires some unconventional thinking, as contrasted to that involved in use of conventional fuels. Because operating costs are so low, importance of (amortized) first costs is heightened. Economical balance between collector size and heat pump capacity is sought. Also, contrary to popular belief, solar heating may be most economical to use in those areas having the longest heating seasons because of the greater use factor for the equipment and greater annual savings in fuel. Significance of the solar house experiment is better appreciated when it is realized that space heating is the largest single consumer of fuel.

Space Heating

Installations Totalled 505,163. *Fuel Oil and Oil Heat 18,* 53 (1959) Jan. (8 pp.)

During 1958 it is estimated that 505,163 oilburner installations were made, a drop of 13% from the 580,447 installed during 1957. Total sales of automatic heating—oilburners, gas burners and coal stokers—jumped 10% to 1,630,290, compared with a 1957 total of 1,579,088. Total gas burner sales for 1958 are estimated at 1,114, 161 and coal stokers at 10,966. Installations of automatic heating at the end of 1958 are estimated to have risen by 6% to and all-time high of 20,691,420, compared with a total of 19,516,099 at the end of 1957.

1959 Directory. Heating, Piping and Air Conditioning Equipment or Industrial, Commercial, Institutional and Public Buildings. *Heating, Piping & Air Conditioning 31,* 1d (1959) Jan. (172 pp.)

Four-part directory contains information on: 1) products advertised in the January issue, classified in "directory style"; 2) alphabetical classification of all products, along with names of manufacturers; 3) product trade names alphabetized, identified with names of manufacturers, and 4) names and addresses of all manufacturers.

Space Heaters

Warm Air Gas-Fired Heating Element. J. M. Baeza. U. S. 2,866,449 (1958) Dec. 30.

Vertical heating element for gas-fired heaters is claimed which is formed of two sheet metal stampings, the central area of which is formed into a raised flat wall below and a corrugated hill-and-valley surface above with a surrounding flanged area. Two such stampings with the flanges in register form a lower combustion chamber with a communicating upper serpentine heating channel between the non-symmetrical corrugations. Burner gases from the base chamber rise to a horizontal flue channel above the corrugations, the whole unit, when assembled with others in a housing, thus providing an enlarged tortuous surface for the air to be heated.

10. EQUIPMENT AND INSTRUMENTATION

Coal Handling

Pulverized-Coal Transport Through Pipes. R. C. Patterson. *J. Eng. Power 81,* 43 (1959) Jan. (12 pp.)

Some typical problems related to pulverized-coal transport for steam generators have been investigated in a long-term test program. Investigation has provided information relative to the performance of a commercial-type exhauster handling air-coal mixtures, friction factors for 8 and 12-in.-diam pipe handling air-coal mixtures, general information as to the flow characteristics of air-coal mixtures in various piping systems, and methods and means for control of coal drifting in horizontal pipe. Friction factors in the range of 0.017-0.035 for 8 and 12-in. pipe are indicated for the usual operating range.

Gas Turbines

Turbines Primed for Big Chance. *Business Week 1533,* 38 (1959) Jan. 17 (2 pp.)

Small gas turbine engines are finding increasing use by air, land and sea, but their future rests on a decision expected soon from Detroit—whether to put them in autos. To date, only about 10,000-11,000 small gas turbine engines have been built in the U. S. for purposes other than propelling aircraft. This compares with an annual output of some 7-million gasoline engines from auto and truck builders and a yearly market for diesels currently estimated at 168,000 units. However, this may change; i.e., an announcement from Chrysler Corp. early in January that one of its experimental automobiles has been cruising along the turnpikes with a gas turbine engine, averaging 19.39 miles/gal of diesel fuel.

Pumps

Maintenance of Centrifugal Pumps. I. J. Karassik and R. Carter. Part 1. *Air Conditioning, Heating and Ventilating 55,* 91 (1958) Nov. (3 pp.); Part 2. *Ibid., 86* (1958) Dec. (5 pp.); Part 3. *Ibid., 56,* 92 (1959) Jan. (5 pp.)

Part 1 presents information on annual inspection, discusses frequency of a complete overhaul and dismantling of a centrifugal pump. Various practices

followed in carrying out repairs of individual pump parts, starting with maintenance of casings, are discussed in Part 2. Final article includes maintenance of shafts, shaft sleeves, bearings and reassembly of pump rotors.

Steam Generation

Cash Savings Can Be Realised by Efficient Steam Storage. *Fuel Efficiency 6,* 28 (1958) Dec. (2 pp.)

Conservation and utilization of stored heat give greater fuel economy than by employing additional steam generating plant, particularly so when the steam is required in large quantities at intermittent intervals. Article amplifies practical application of steam accumulator described previously in the magazine and shows what it means in terms of L.S.D.

Valves

What to Consider When Selecting Valves. C. A. Dopp. *Heating, Piping & Air Conditioning 31,* 163 (1959) Jan. (16 pp.)

Certain general considerations in selecting valves are common to all types. Among the considerations are service factors (temperature, pressure, fluid handled, pressure drop and frequency of operation), type of end connection and various flange facings. (Proper application of these facings in accordance with standards are summarized in easy-to-use tables.) Helpful information for selection of bolts and bolting materials for flanged end connects is given. Several of the many standard gasket designs are presented, with notes on their application. Strength and corrosion resistance must be considered when selecting the valve body materials. Applications and limitations of valves of various materials are presented.

Welding

What Do the Russians Weld With? P. Trippe. *Product Eng. 30,* 64 (1959) Jan. 19 (4 pp.)

British observer reports on design and performance of latest Soviet production-welding machines. Three U. S. experts put facts into perspective. Included in this report: Electro-slag welders, highly touted for ultrathick sections; portable submerged-arc welders for work in confined spaces; stored-energy spot welders to meet needs for delicate assemblies.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Are Cathodic Techniques for You? *Chem. Eng. 66,* 154 (1959) Jan. 12 (3 pp.)

Many new practices have proved successful in protecting sea water screens, large diameter pipes, heat exchangers and related equipment. Dow's Texas Division's experience indicates cathodic protection definitely should be considered for process equipment. Description of Dow's method used at plants A and B, Freeport, Texas. Located about seven miles apart, both plants depend mainly on sea water in processing and heat exchange.

Rectifiers Protect Bare Pipeline on Standard of Ohio's Products System. L. H. West. *Oil Gas J. 57,* 80 (1959) Feb. 2 (5 pp.)

Almost 50% of Sohio's high-pressure products pipelines are bare. Corrosion engineer for company's products-pipeline division tells how cathodic protection of 206 miles of the bare pipe is expected to save about $1 million over and above initial investment and operating expense in the first three years. Calculations are based on projection of leak-expectancy curves.

Coatings

Offshore Corrosion Costs Cut by 'Cold Galvanizing'. *World Oil 148,* 234 (1959) Jan. (3 pp.)

Among coatings currently available for protection of offshore structures and equipment is an inorganic silicate, highly filled with metallic zinc, that can be sprayed on the surface, then chemically "cured" to form a chemical and physical bond between the metal surface and the metallic zinc coating. Coating, in effect, is a "cold galvanizing," but when properly applied, outlasts conventional galvanizing.

Corrosion

D.S.I.R. Corrosion of Metals Group, National Chemical Laboratory, Teddington. F. Wormwell. *Corrosion Tech. 6,* (1959) Jan. (5 pp.)

Department of Scientific and Industrial Research has been responsible for investigations on the corrosion of metals since 1924, when a Corrosion Research Committee was established. In 1927, research on atmospheric corrosion was taken over by D.S.I.R. and in 1928 the group was transferred from the Royal School of Mines to the then Chemical Research Laboratory at Teddington. This establishment had been inaugurated several years previously as a separate D.S.I.R. station situated in the same grounds as the National Physical Laboratory. Quite recently it has achieved the status of National Chemical Laboratory; but the 'C.R.L.' (now the 'N.C.L.') has always derived great benefit from its proximity to its much larger and older sister station.

Corrosion of Steel Weldments. J. U. MacEwan and H. H. Yates. *Corrosion 15,* 2t (1959) Jan. (5 pp.)

Forty-six different steel weldments were subjected to

12 months' alternate immersion in 3% sodium chloride solution. Weight loss was more dependent on type of steel than nature of the weld, but severity of corrosion in the weld region was dependent on both factors. Apparatus was constructed to measure short circuit current between exposed surfaces of parent metal and weld metal. Rapid fluctuations in this current made precise determinations difficult, but average values were reproducible if a set conditioning procedure was used prior to measurement. Variations in current with sodium chloride concentration and with oxygen content of a gas mixture bubbled into the solution were determined, and the activation energy in a 3% sodium chloride solution increased from 4-6 kcal/mole as the oxygen content of the gas mixture decreased from 100 to 20%.

A Critical Analysis of Pitting Corrosion. N. D. Greene and M. G. Fontana. *Corrosion 15,* 25t (1959) Jan. (7 pp.)

Critical analysis of the literature on pitting corrosion published during the past 35 years is presented. Definition of pitting and factors influencing this type of attack are considered. An examination of theories of pitting corrosion and methods used to study this form of corrosion also are included. Bibliography cites 95 references.

An Electrochemical Study of Pitting Corrosion in Stainless Steels. Part 1. Pit Growth. N. D. Greene and M. G. Fontana. *Corrosion 15,* 32t (1959) Jan. (7 pp.)

By means of a unique artificial pit specimen, pit growth on 18% chromium—8% nickel stainless steel has been measured and characterized. Effects of solution composition, agitation, atmosphere, corrosion current interruption, chloride ion concentration and inhibitor additions have been investigated. Pit interaction during pit growth also has been verified and evidence of ion screening at pit sites has been experimentally observed for the first time.

An Electrochemical Study of Pitting Corrosion in Stainless Steels. N. D. Greene and M. G. Fontana. *Corrosion 15,* 39t (1959) Jan. (6 pp.)

Artificial pit technique has been used to study the electrochemistry of the pitting corrosion of 18% chromium—8% nickel stainless steel in ferric chloride solutions. Pitting corrosion has been observed to be a highly complex, time-dependent phenomenon. Concepts of polarization and electrochemical control must be modified when applied to pitting attack. New concept of electrochemical action during pitting, based on the mixed potential theory, has been proposed.

High Temperature Corrosion Product Films on Aluminum. V. H. Troutner. *Corrosion 15,* 7t (1959) Jan. (2 pp.)

Corrosion product films formed on aluminum in aqueous environments at high temperatures were examined with the electron microscope. Technique is described for the preparation of electron microscope replicas of the surface of the corrosion product films adjacent to the metal. Electron micrographs are shown of corrosion product films formed during various stages of corrosion in high purity water, and in corrosion inhibited systems. Corrosion inhibition was found to be associated with different crystalline structures of the corrosion product films.

Corrosion Measurement

A Radioactive Corrosion Probe. D. Anson. *J. Inst. Fuel 32,* 10 (1959) Jan. (6 pp.)

Internally cooled steel probes are in general use for the estimation of corrosion rates of cooled surfaces exposed to flue gases. By using a radioactivated probe the metal lost during a test may be estimated by a count of the radioactivity of the probe washings. It may be possible to develop a probe on this principle to give a continuous indication of corrosivity. Article describes design and performance of a simple prototype probe which demonstrated that accurate results should be possible using probe exposure times as short as 10 minutes, and counting times of two minutes with convention counting equipment. With the design described, health hazards due to radioactivity are very slight provided that elementary precautions are taken to avoid direct handling of radioactive parts.

Metals

Are American Steel Methods Growing Old? J. B. Austin. *Ind. Res. 1,* 23 (1959) Jan. (9 pp.)

The press argues that while Britain, Sweden, West Germany, France and Russia develop and adopt the latest steel processes, America clings to its recently-outdated methods. An authority who has recently returned from Russia takes a searching look and writes on the industry that is one of this country's basic barometers.

Sub-Zero Temperature Research Improves Materials. C. L. Schuettler. *Ind. Laboratories 10,* 9 (1959) Jan. (6 pp.)

Use of sub-zero temperatures is increasing to such an extent that it is now considered to be of major importance in fields of research, testing and industrial processing. Physical characteristics of most steels may be definitely improved through further decomposition of austenitic structure at low temperatures. With some steels, cold treatment to –120°F has resulted in an increase of 12-15 points in Rockwell hardness. Decomposition of austenitic structure results in a transformation into harder martensite

which theoretically increases the hardness and strength of the steel. Data discussed summarize conclusions derived from research projects.

Coatings

Device for Metal Coating Pipelines, Particularly of Power Stations. P. von Arx (assigned to P. von Arx & Co.) U. S. 2,865,321 (1958) Dec. 23.

Apparatus for coating interior of pipes with sprayed metal (metal point) is comprised of a carriage moving longitudinally in the pipe upon rollers supporting centrally several equiangularly spaced sprays mounted on the frame for rotation over 90 degrees by gear and motor, with control cables for moving carriage and sprays, and spray supply tubing for supplying the sprays.

Pipe Coating Method and Apparatus. P. H. Timothy and C. W. Shaw (assigned to Southern Natural Gas Company.) U. S. 2,863,204 (1958) Dec. 9.

Apparatus is claimed for continuous coating of a pipe with a heavy mastic coating and the laying of said pipe. It includes a vehicle or barge with a movable carriage which is clamped while a given length of pipe is coated by moving the vehicle. Carriage contains a coat-compacting device of circumferential rollers, an extrusion nozzle surrounding the pipe with rotating adjustable annulus for fixing the coat thickness, a hopper for feeding screw-driven extruders for applying the blended barite-bitumen coat and with a feed rate controlling the speed at which the carriage is moved along the pipe.

Pipe Lining Machine. A. J. Perkins (assigned to Perkins Pipe Linings, Inc.) U. S. 2,865,322 (1958) Dec. 23.

Improved pipe lining machine for applying mortar coating to interior of pipes, especially to small-diameter pipes, is claimed. It consists of a roller-supported, elongated pipe support, carrying, at forward end, a hollow-centered motor driving a mortar feed shaft extending there through to supply mortar to the centrifugal head of the machine, where ports permit extrusion of mortar.

12. ANALYTICAL METHODS AND TESTS

Carbon

Analytical Procedure for Compounds Containing Boron, Carbon and Hydrogen. H. Allen, Jr. and S. Tannenbaum. *Anal. Chem. 31,* 265 (1959) Feb. (4 pp.)

Simultaneous determination of carbon, hydrogen and boron in a single sample of organoboron compound involves quantitative combustion of sample, using oxygen, in an Inconel bomb at high temperature (500° C) and pressure. Resulting carbon dioxide, water, and hydrated boric oxide are separated and determined. Spontaneously flammable compounds are handled in a nitrogen atmosphere prior to combustion. Method may be applied to hydrocarbon analyses.

Chromatography

Correlation of Thermal Conductivity Cell Response with Molecular Weight and Structure. Quantitative Gas Chromatographic Analysis. A. E. Messner, D. M. Rosie and P. A. Argabright. *Anal. Chem. 31,* 230 (1959) Feb. (4 pp.)

Number of compounds differing in type and structure are studied to determine their relative thermal response. Definite linear correlation exists between thermal detector response and molecular weight within a structurally similar homologous series. Technique is applicable to all gas chromatographic analyses employing helium as a carrier gas.

Gas-Liquid Chromatographic Analysis of Some Oxygenated Products of Cool-Flame Combustion. G. Kyryacos, H. R. Menpace and C. E. Boord. *Anal. Chem. 31,* 222 (1959) Feb. (4 pp.)

Gas-liquid chromatographic method is developed for analysis of cool-flame combustion products of hydrocarbons. Fourteen hydrocarbons are isolated and identified, including ethylene oxide, acetone, methyl ethyl ketone, and crotonaldehyde.

Response Time and Flow Sensitivity of Detectors for Gas Chromatography. L. J. Schmauch. *Anal. Chem. 31,* 225 (1959) Feb. (6 pp.)

Quantitative relationship exists between band shape and the ratio of response time to band width in gas chromatography techniques. To prevent band broadening and asymmetry, the response time of the detector must be short. Adequate band shape is obtained where the ratio is 0.2 or less.

Separation of Paraffin-Cycloparaffin Portion of Naphtha into Normal, Branched and Cycloparaffins. M. S. Norris and J. G. O'Connor. *Anal. Chem. 31,* 275 (1959) Feb. (5 pp.)

Saturated fraction of naphtha is separated into straight-chain, branched and cyclic fractions by use of molecular sieves. Isopentane elutes the branched and cyclic fractions while *n*-pentane elutes the straight-chain compounds. Branched and cyclic fractions are further resolved by separation on silica gel column, being differentially eluted with methyl Carbitol.

The Composition of Ammoniacal Liquors. Part 1. Analytical Considerations. L. Barker and N. W. Hollingworth. *J. Appl. Chem. 9,* 11 (1959) Jan. (6 pp.)

Influence of the source of an ammoniacal liquor on its composition is indicated. Analysis of liquors is discussed with special reference to the determination of amounts of organic constituents. Loss of phenols during analysis by oxidation inalkalis and pitch formation on distillation can be eliminated by using chromatographic separations.

The Composition of Ammoniacal Liquors. Part 2. Analysis of the Phenolic Content of Chromatography. L. Barker and N. W. Hollingworth. *J. Appl. Chem. 9,* 16 (1959) Jan. (10 pp.)

Procedure adopted consists in placing 1 ml of an acidified ammoniacal liquor on an acidified Celite column and elution with *cyclo*hexane to obtain all the monohydric phenols in one band, except phenol which follows as a separate band. Dihydric phenols are then eluted separately or in groups of isomers by the addition of butanol in successively increasing amounts to the *cyclo*hexane eluent. The monohydric phenols are separated on a second Celite column impregnated with sodium silicate solution by elution with *cyclo*hexane. Amounts of all the compounds are determined directly in the eluates by ultraviolet spectrophotometry.

Dust

Characteristics of Airborne Particles. T. A. Rich. *J. Eng. Power 81,* 7 (1959) Jan. (6 pp.)

Airborne particulates are primarily responsible for the visible effects of air pollution and contribute appreciably to total mass of pollutants. A substantial fraction of the particulates is submicroscopic so optical methods are not suitable for following their life history. Techniques for measuring number and average size of submicroscopic particles over wide ranges have been developed but are not widely known or used outside the laboratory. Review is given of some of the more useful parameters of particles and methods by which these can be measured.

Gas Analysis

Gas Analysis—A New Tool for Determining the Chemical Stability of Hermetic Systems. H. O. Spauschus and R. S. Olsen. *Refrigerating Eng. 67,* 25 (1959) Feb. (6 pp.)

In an effort to develop analytical tools for following reactions in hermetic units, General Electric has been evaluating gas analysis using the analytical mass spectrometer and, when desirable, supplementing these analyses with gas chromatography. These measurements admirably fulfill most of the requirements. Gases which are analyzed can be taken directly from actual hermetic units operating under known controlled conditions. Since quite small samples are required (a few standard cc of gas) the measurement does not affect operation of the unit and the tests can be continued as long as desired.

Hydrogen Sulfide

Spectrophotometric Determination of the Acid Dissociation Constants of Hydrogen Sulphide. A. J. Ellis and R. M. Golding. *J. Chem. Soc.,* 127 (1959) Jan. (4 pp.)

First acid dissociation constant of hydrogen sulfide has been found by spectrophotometry to be 9.5×10^{-8} at 25°, and the second to be 1.0×10^{-14} at 20°. Method was based on the fact that HS^- ions absorb strongly at 2300 A, whereas for H_2S molecules and S^{2-} ions the absorption is much less. The logarithm of the molar extinction coefficient at 2300 A for HS^- ions is 3.90 ± 0.01.

Infrared Spectroscopy

Low-Cost Infrared: Its Impact on Research. *Ind. Laboratories 10,* 39 (1959) Jan. (4 pp.)

During the last 15 years, infrared spectrophotometers have developed from rather crude machines requiring tedious operator manipulations to highly automatic instruments. Currently, a variety of versatile infrared instruments and instrument accessories are available for exacting research. However, because of cost and complexity of the first instruments, it was not until 18 months ago when the first low-cost and simple-to-operate spectrophotometers were introduced, that infrared found widespread use. Description of some of these newer instruments and areas of application.

Sulfur Determination

Organic Sulphur Compounds in Alberta Cracked Distillates. C. H. Amberg. *J. Inst. Petrol. 45,* 1 (1959) Jan. (8 pp.)

Comparatively rapid method has been developed for the identification of sulfur compounds in high-sulfur cracked distillates. Fractionated samples were chromatographed by displacement from an alumina column. Liquid cuts were thus obtained that were enriched with respect to organic sulfur compounds. These, in turn, were subject to analysis by a combination of gas-liquid partition chromatography and mass spectrometry.

Water

Automatic Coulometric Titrator for the Karl Fischer Determination of Water. Application of the Leeds & Northrup Alternating Current-Operated pH Indi-

cator to the Control of Titrations. M. T. Kelley, R. W. Stelzner, W. R. Laing and D. J. Fisher. *Anal. Chem. 31,* 220 (1959) Feb. (2 pp.)

Automatic cutoff attachment is designed for the Leeds & Northrup *p*H indicator. This is used in constant-current coulometric titration of water with Karl Fischer reagent. Other *p*H, millivolt or dead-stop titrations can be controlled by this modified *p*H indicator.

Determination of Water by Titration with Coulometrically Generated Karl Fischer Reagent. A. S. Meyer, Jr. and C. M. Boyd. *Anal. Chem. 31,* 215 (1959) Feb. (5 pp.)

Water content of organic solvents is determined by a coulometric procedure using electrolytically generated iodine in a solution of depleted Karl Fischer reagent in ethylene glycol. Water concentration as low as 5 gamma ml is determined with good accuracy. Method eliminates necessity of preparation, standardization and storage of a standard reagent solution.

X-Ray Methods

X-Ray Analysis Technique for Very High Temperatures. E. Aruja, J. H. Welch and W. Gutt. *J. Sci. Instruments 36,* 16 (1959) Jan. (5 pp.)

New powder-diffraction technique for very high temperatures is described in which a thermocouple combines functions of sample support, heating and temperature measurement. This device is simple, compact and inexpensive, and has proved to be very reliable. Maximum working temperature depends on the thermocouple material, and is normally 1750°C using 5/20 rhodium-platinum, or 1850°C with 20/40 rhodium-platinum couples.

Hydrogen Cyanide

Determination of Hydrogen Cyanide and Hydrogen Sulphide in Air. H. H. Roth (assigned to Mine Safety Appliances Company.) U. S. 2,864,747 (1958) Dec. 16.

Hydrogen cyanide and hydrogen sulfide in air are determined by drawing the air through an absorbing liquid to obtain a solution. Solution is passed to a silver-electrode half-cell with rapidly rotating electrode and the EMF from this cell is used, with a reference electrode, to indicate the concentration of cyanide. This is accomplished by establishing a linear relationship of concentration to EMF which can be shown on previously calibrated graphs.

13. BASIC SCIENCE

Ammonia

Infrared Spectra, Structure, and Hydrogen-bonding in Ammonium Salts. T. C. Waddington. *J. Chem. Soc.* 4340 (1958) Dec. (5 pp.)

Infrared spectra of a series of ammonium salts of monobasic acids have been examined. Spectra of the salts NH_4N_3, NH_4HF_2, NH_4NCO, NH_4NCS, NH_4NO_2, NH_4, NO_3 show a combination frequency $\gamma_4 + \gamma_6$, involving a torsional mode, and a multiplicity of lines at 3000 cm; all these salts have structures differing from those of the potassium and rubidium salts. It is concluded that in these salts the ammonium ion is locked in position in the crystal lattice by hydrogen bonding. No combination frequency or multiplicity of lines is found in NH_4C10_4, NH_4BF_4, $NH_4B(C_6H_5)_4$ or NH_4PF_6 and these salts are isomorphous with the corresponding potassium and rubidium salts. It is concluded that in these salts that NH_4^+ ion is free to rotate. In NH_4SO_3F and $NH_4SO_3 \cdot CH_3$, though a multiplicity of lines at 3000 cm^{-1} is found, no combination frequency of the torsional mode is detectable and the salts are isomorphous with the potassium and rubidium salts.

Carbon

The Molecular Structure of Carbon Suboxide. R. L. Livingston and C. N. R. Rao. *J. Am. Chem. Soc. 81,* 285 (1959) Jan. 20 (3 pp.)

Molecular structure of carbon suboxide has been studied by electron diffraction by the visual interpretation of sectored plates. Bond distances obtained were C-C $= 1.28 \pm 0.01_5$ A and C-O $= 1.16 \pm 0.01_5$ A. Diffraction data are consistent with a linear symmetric structure but small deviations from linearity cannot be excluded.

Heat Transfer

Condensation of Vapor in the Presence of Noncondensing Gas. F. Votta, Jr. and C. A. Walker. *A. I. Ch. E. J. 4,* 413 (1958) Dec. (5 pp.)

Results of study indicate possibility that rate of gas-phase heat and mass transfer may be proportional to heat transfer coefficient and a single driving force. Driving force suggested is a function of the difference in availability of energy. Proposed procedure has successfully correlated experimental data covering a wide range of conditions; however, it is believed that considerable additional testing of the method against other experimental data is needed. Reliable mass transfer data for gas mixtures containing a high concentration of vapor would be especially useful.

Contribution to the Theory of Controlled Heating Processes. H. Jung. *Appl. Mech. Rev. 12,* 50 (1959) Jan. (From *ZAMM 38,* 56 (1958) Jan./Feb. (14 pp. German text.))

A homogeneous isotropic solid at prescribed initial temperature and without sources of heat is surrounded by another medium with a given time variation of temperature. In contrast to the usual conception author assumes a linear dependence both of the conductivity and of the outer conductivity upon the temperature. The resulting nonlinear problem is linearized and solved by a suitable modification of the methods known from the theory of perturbations. The influence of the nonlinearity is shown graphically on the concrete examples of a wall, hollow cylinder and sphere. There has been found no essential influence on the first perturbation function. Paper presents a fine contribution to the analytic theory of heat conduction. A more careful proof reading would have eliminated some unnecessary misprints.

V. Vodicka, Czechoslovakia

The Dynamics of the Processes of Heat and Humidity Exchange in Refrigerator Cold Chambers. S. G. Tchucklin. *Appl. Mech. Rev. 12,* 53 (1959) Jan. (From *Trudi Odessk. Tekhnol. in-ta Pishchev. i Kholodiln. Prom-Sti 6,* 132 (1955) (14 pp. Russian text.))

Usual formulation of the problem of heat and humidity exchange between the air and the cooled surface is complicated by the introduction of hoar frost forming on the cooling surface. Formulas are presented for the time precipitation and maximum thickness of formation of hoar frost on a pipe and on a flat plate. Method is indicated for calculating the temperature and relative humidity of the atmosphere in a cold chamber, degree of dehydration of stored products and the other parameters of the process, on a time basis. Numerical example is appended.

V. S. Zhukovskii
Courtesy Referativnyi Zhurnal, USSR
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The Effect of Turbulent Separation of Superheated Vapor and an Experimental Confirmation of the Hilsch-Fulton Hypothesis. V. P. Alexeev and V. S. Martynovsky. *Appl. Mech. Rec. 12,* 48 (1959) Jan. (From *Izv. Akad. Nauk SSR, Otd. Tekh. Nauk.* 71 (1956) No. 1 (7 pp. Russian text.))

It is observed that the effect of temperature separation is impaired by working with humid air. The results of test made in a 9-mm turbulence tube, with carbon dioxide, methane, ammonia and dry air are described. Special experiments were conducted to verify the Hilsch-Fulton hypothesis. Authors' experiments fundamentally confirm this hypothesis, but substantial divergences have also been observed, associated with the manner of distribution of the angular velocities.

M. G. Dubinskii
Courtesy Referativnyi Zhurnal, USSR
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Graphs Help to Solve Shellside Heat Transfer and Pressure Drop Problems for Gases and Vapors. N. H. Chen. *Chem Eng. 66,* 115 (1959) Feb. 9 (4 pp.)

Previous discussion on graphical short-cuts for solving heat exchanger problems dealt with calculations for liquids on the shell side of baffled, tubular exchangers. Appropriate modification of some of the equations and graphs from that article provide current article's equally useful tools for dealing with shellside flow of gases and vapors. (See *Gas Abstracts 14,* 289.)

Heat Transfer and Friction in Swirling Turbulent Flow. F. Kreith and D. Margolis. *Appl. Mech. Rev. 12* (1959) Jan. (From *Heat Trans. and Fluid Mech. Inst.,* 126 (1958) June (17 pp.))

Swirl was communicated to flow through a straight pipe by means of a twisted metal ribbon along the axis, or alternatively, a coiled wire. Inside surface heat-transfer coefficients were found to increase as much as fourfold over coefficients observed at same velocity in purely axial flow. Coefficients were found to depend on centrifugal force component. However, at comparable Reynolds numbers and swirling motions, heat-transfer coefficients for water were found to be larger than coefficients for air. Reason for this difference is not definitely known, although qualitatively compatible with flow phenomena in a vortex type flow. It is shown that phenomena are result of free convection motion induced by centrifugal force due to temperature difference in rotating fluid.

From authors' summary by H. S. Ribner, Canada

Kinetics of Heat and Mass Transfer in a Layer of Foam. I. P. Mukhlenov and E. S. Tumarkina. *Zur. Prikladnoi Khimii 31,* 1647 (1958) No. 11 (9 pp. Russian text.)

Effect of gas velocity, depth of initial liquid layers and Prandtl number is determined and equations are given for calculation of coefficients of heat and mass transfer, H_2O condensation and NH_3 absorption.

Assoc. Tech. Services, Inc.

New Charts Provide Quick Way to Radiant Heat Transfer. A. Feder. *Chem. Eng. 66,* 101 (1959) Jan. 26 (4 pp.)

Article discusses simple and complete graphical

solution which greatly decreases calculation time while retaining accuracy. Technique requires insertion of variables into three "go-around" charts which yields a radiant heat transfer coefficient. Charts are based on hydrocarbon-air combustion gases, specifically nonluminous gases (CO_2 and H_2O) resulting from the combustion with air of a fuel having a 0.182 hydrogen/carbon weight ratio.

Kinetics

Limitations of the Reflected Shock Technique for Studying Fast Chemical Reaction and Its Application to the Observation of Relaxation in Nitrogen and Oxygen. R. A. Strehlow and A. Cohen. *J. Chem. Phys. 30*, 257 (1959) Jan. (9 pp.)

Strip film and multiple spark schlieren pictures of reflected shocks were taken in the gases He, A, N_2, O_2, H_2, NO, CO_2, N_2O, CH_4 and C_3H_8. Interaction of the reflected shock with the boundary layer behind the incident shock was observed in all gases except He and A. The bifurcation and acceleration associated with the interaction limits the use of the reflected shock region for high-temperature kinetic and equilibrium studies. It was possible to minimize the effects of this interaction by using gases with high γ and confining measurements to a region near the back wall. Reflected shock observations agreed with Mark's theory of the development of bifurcation but disagreed with his predicted deceleration of the reflected shock.

Nuclear Energy

Kinetic of D Atom Reactions with H_2, CH_4, and D_2CO. R. Klein, J. R. McNesby, M. D. Scheer and L. J. Schoen. *J. Chem. Phy. 30*, 58 (1959) Jan. (3 pp.)

Activation energies and steric factors of the abstruction reactions $D+D_2CO \rightarrow D_2+DCO$ and $D+CH_4 \rightarrow HD+CH_3$ have been determined by the technique of competing reactions. Mixtures of formaldehyde-d_2 and H_2 as well as formaldehyde-d_2 and methane were photolyzed over a temperature interval in the region of 350°. Measurements of the HD/D_2 product ratios as a function of temperature, initial compositions, and light intensity, give the activation energies and steric factors for $D+D_2CO \rightarrow D_2+DCO$, the values $E=4.8 \pm 0.6$ kcal, $P=0.04$, and for $D+CH_4 \rightarrow HD+CH_3$, the values $E=7.8 \pm 0.06$ kcal, $P=0.025$. These are based on the values $E=5.4$ kcal and $P=0.11$ for the reaction $D+H_2 \rightarrow HD+H$.

Valence-Bond Interpretation of Electron-Coupled Nuclear Spin Interactions; Application to Methane. M. Karplus and D. H. Anderson. *J. Chem. Phys. 30*, 6 (1959) Jan. (5 pp.)

Valence-bond theory, based on the approximate second-order perturbation method of Ramsey, has been developed for the calculation of the electron-coupled nuclear spin interactions in a $^1\Sigma$ molecule. It has been found possible to derive a general formula which expresses the proton-proton coupling constant in terms of functions that are easily evaluated with the Rumer-Pauling diagrams. The theory is such that, for nonbonded protons, the coupling constant is a sensitive direct measure of deviations from perfect pairing. Application of the theory to methane leads to a numerical value for the coupling constant in agreement with the experimental result. This agreement indicates that contributions of nonperfect-pairing structures to the ground-state wave function of methane are so small that they can have little effect on the energy.

Olefins

Relative Rates of Reactions of Oxygen Atoms with Olefins. R. J. Cvetanovic. *J. Chem. Phys. 30*, 19 (1959) Jan. (8 pp.)

Relative rates of addition of oxygen atoms in their ground electronic state to a number of olefins in the gas phase have been determined at room temperature. These reactions exhibit the following regularities: 1) Systematic variation of the rates with the structure of the olefins; 2) specificity with respect to the position of addition of oxygen atoms, and 3) partial molecular rearrangement of the addition products according to definite rules. The observed structural effects and some close analogies with certain olefin addition reactions in solution are discussed in the light of electronic theories of organic chemical reactions. A comparison is made of the absolute values of the rate constants of the reactions of oxygen atoms with olefins, derived from various sources.

Organic Sulfur

Synthetical Applications of Activated Metal Catalysts. Part 6. Desulphurisations with Raney Cobalt. G. M. Badger, N. Kowanko and W. H. F. Sasse. *J. Chem. Soc.*, 440 (1959) Jan. (5 pp.)

Raney cobalt has been used to desulfurize dibenzothiophen and a number of acylthiophens, thiophencarboxylic acids, thiazoles and thioamides. In general it is less effective than Raney nickel, but some differences have been noted.

Phase Equilibria

Correlating Heats of Solution and Vapor-Liquid Equilibria. Construction of Ponchon Diagrams. D. F. Othmer, R. C. Kowalski and L. M. Naphtali. *Ind. Eng. Chem. 51*, 89 (1959) Jan. (4 pp.)

Heats of solution of solids, liquids and gases in

liquids control heat balances in Ponchon diagrams and enthalpy charts of solutions of solids in liquids. However, few calorimetric data are available for usual construction and theoretical calculations. Logarithmic plot of partial pressures of a solvent out of a solution vs a temperature scale derived from vapor pressures of a reference substance gives straight lines whose slopes allow determination of heat of solution or of infinite dilution through a novel integration procedure. From these a precise plot of isotherms of integral heats of solution vs liquid composition is developed. Simple, precise method is demonstrated for constructing a Ponchon diagram for distillation of the irregular system, chloroform-ethanol.

Isobaric Vapor-Liquid Equilibria. K. C. Chao. *Ind. Eng. Chem. 51,* 93 (1959) Jan. (2 pp.)

Effect of changing temperature on activity coefficient equations for isobaric vapor-liquid equilibrium systems has usually been overlooked. Method to take this into account has been developed. Redlich and Kister equation of activity coefficients in binary solutions is modified for isobaric conditions, giving significant improvement of correlation for some systems. Modified equations are appropriate for correlation of isobaric vapor-liquid equilibria when the system shows a wide boiling range and considerable heat of solution.

Radioactivity Applications

Effect of Radioactive Radiation on the Physicochemical Properties of Solids. V. I. Spitsyn. *Izvestiya Akad. Nauk S.S.S.R.,* 1296 (1958) No. 11 (7 pp. Russian text.)

Report of study on effect of the level of S^{35} radioactivity in various sulfates on the rate of isotope exchange and on the adsorptive and catalytic properties of these solids.

Assoc. Tech. Services, Inc.

Sulfur

The Heat Capacity of Sulfur from 25 to 450°, the Heats and Temperatures of Transition and Fusion. E. D. West. *J. Am. Chem. Soc. 81,* 29 (1959) Jan. (9 pp.)

Heat capacity of sulfur (99.999% pure) has been determined from 25-450° with an accuracy of 0.1-0.2% using an adiabatic calorimeter. Heat of transition of rhombic to monoclinic sulfur is 401.7 j./g.-atom at 95.31°, the transition temperature at saturation pressure. The heat of fusion is 1717.6 j./g.-atom at the triple point, 115.18°. Data indicate a previously unreported transition near 101° to which an enthalpy change of 1.6 j./g.-atom has been assigned. Behavior of the heat capacity of the liquid in the region of its maximum at 159.1° has been investigated in detail.

Thermodynamics

A Review of the Thermodynamic, Transport and Chemical Reaction Rate Properties of High-Temperature Air. C. F. Hansen and S. P. Heims. *Appl. Mech. Rev. 12,* 48 (1959) Jan. (From *NACA Tech. Note 4359* (1958) July.))

Thermodynamic and transport properties of high-temperature air, and the reaction rates for the important chemical processes which occur in air, are reviewed. Semiempirical, analytic expressions are presented for thermodynamic and transport properties of air. Examples are given illustrating the use of these properties to evaluate 1) equilibrium conditions following shock waves, 2) stagnation region heat flux to a blunt, high-speed body, and 3) some chemical relaxation lengths in stagnation region flow.

From authors' summary

Use Enthalpy for Two-Phase ΔP. A. Doll-Steinberg. *Petrol. Refiner 38,* 217 (1959) Jan. (6 pp.)

Article shows how to derive rules which simplify the task of constructing the phase diagram from the thermodynamic relations between the properties of the fluid. It is also shown how it is possible to calculate from the properties of the fluid at the outlet from the heater the conditions necessary to avoid peaking (i.e., a maximum of temperature occurring before the outlet of the heater.) Method saves time when fired-heater pressure drop for vaporizing fluids is being calculated.

Viscosity

How P & T Change Liquid Viscosity. W. R. Gambill. *Chem. Eng. 66,* 123 (1959) Feb. 9 (4 pp.)

Effect of high pressure on viscosity of subcooled liquids is imperfectly understood at present. Though μ_L has a greater pressure variation than almost any other pure-liquid property, the effect is rarely significant when the pressure is less than 10-40 atm. (Exact value depends upon nature of the liquid.) Liquid viscosity increases with pressure for all liquids except water below 30°C (and some aqueous solutions); the increase is almost linear with pressure up to about 1000-4000 atm, whereas at higher pressures the rate increases and variation becomes logarithmic.

Water

Cutting the Cost of Heavy Water. M. C. Reece. *Chem. Process Eng. 40,* 16 (1959) Jan. (3 pp.)

British company recently announced details of a new process for heavy water which, it was claimed, would produce this material at a price below the American figure of $28/lb. Other new processes and modifications to existing plant were described in papers presented at the Geneva conference on the peaceful uses of atomic energy.

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